THE YUKON ECONOMY
ITS POTENTIAL FOR GROWTH AND CONTINUITY

VOLUME VIII REFERENCE STUDY ON FOREST RESOURCES

D. Wm. Carr & Associates Ltd.

Ottawa

July, 1968

ECONOMIC STUDY - YUKON TERRITORY

FOREST RESOURCE STUDY

December 1967

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Prince George, B.C.

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Forest Resource Study

by

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Prince George

Background study prepared for D. Wm. Carr & Associates Ltd. as part of the Yukon Economic Studies undertaken for the Department of Indian Affairs and Northern Development and the Government of Yukon Territory.

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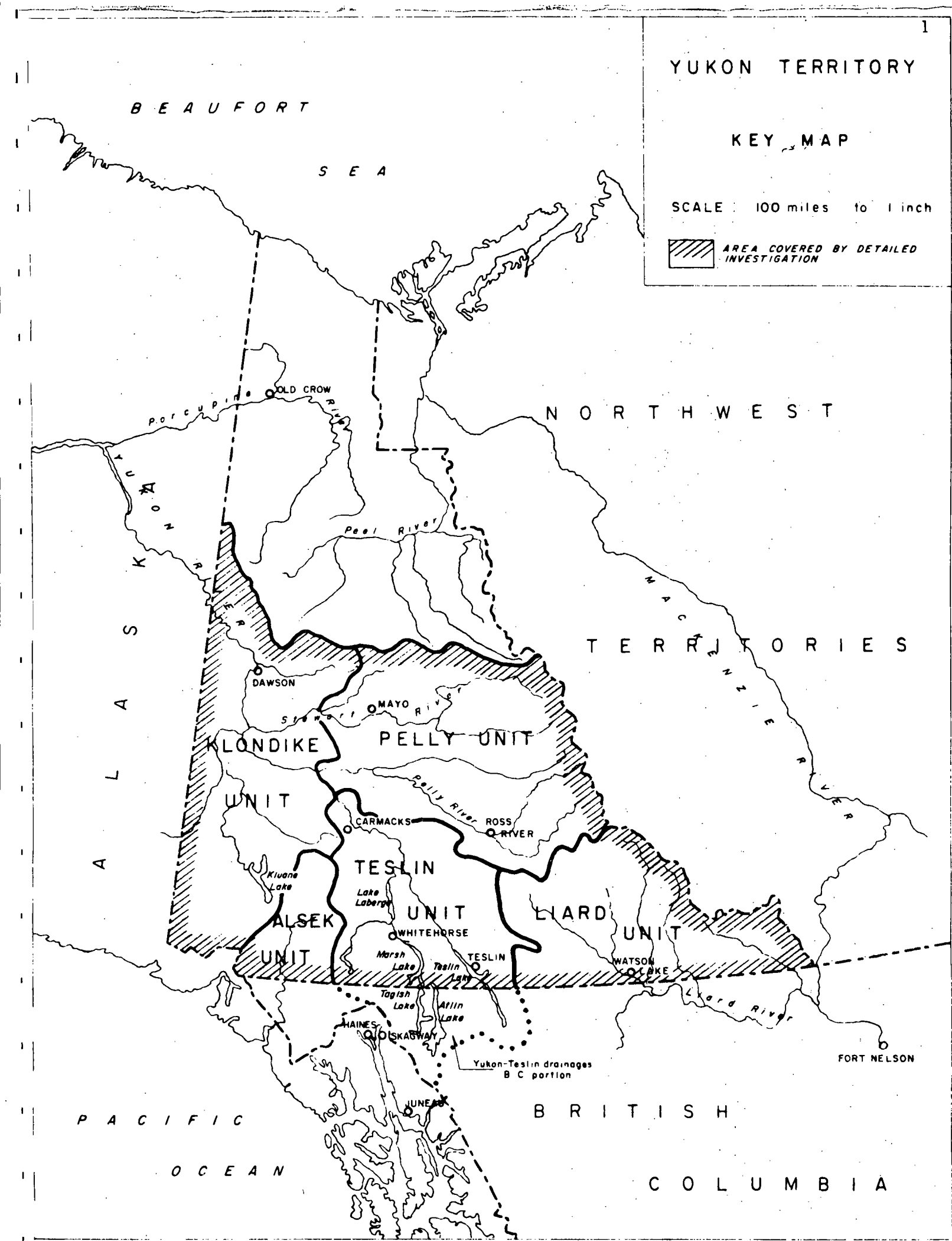
YUKON TERRITORY
KEY MAP
SCALE : 100 miles to 1 inch
AREA COVERED BY DETAILED INVESTIGATION
BEAUFORT
SEA
OLD CROW
Porcupine River
NORTHWEST
TERRITORIES
Peel River
Yukon River
ALASKA
DAWSON
MAYO
Stewart River
KLONDIKE
UNIT
PELLY UNIT
Pelly River
Mackenzie River
CARMACKS
ROSS RIVER
Kluane Lake
TESLIN
Lake Laberge
ALSEK
UNIT
UNIT
WHITEHORSE
Marsh Lake
Tagish Lake
Teslin Lake
TESLIN
Atlin Lake
LIARD
UNIT
WATSON LAKE
Liard River
HAINES
SKAGWAY
Yukon-Teslin drainages
B C portion
FORT NELSON
JUNEAU
PACIFIC
OCEAN
BRITISH
COLUMBIA

ECONOMIC STUDY - YUKON TERRITORY

FOREST RESOURCE STUDY

I. INTRODUCTION

A. Purpose and Scope of the Study

The purpose of the study is to evaluate the forest resource of the Yukon and indicate both the short and long term development potential. The contribution of the forest resource to the Yukon economy is projected in terms of product value, and employee earnings. The demands that development of the resource would make on the economy in terms of capital, power, transportation, and other services are also projected.

The scope of the inventory study was limited to assimilation of existing data but over 3000 miles of reconnaissance flying was done to check accuracy and to update the data where changes have occurred.

The potential for development of the forest resource of the entire Territory has been considered, but extreme northern areas contain very little merchantable forest and are unlikely to be developed for many years. (The main value of these forests will be to supply fuelwood and building logs for the very small population). Tables and summaries throughout this report refer to the portion of the Yukon south of the Ogilvie and Selwyn Mountains which is the area most likely to be developed and probably includes 90% of all of the merchantable timber in the Yukon. This area in which detailed investigations were concentrated is shown on the Key Map.

B. Summary

Short Term Development

Investigation of economic factors affecting development of forest operations indicates that development of the industry in the next 15 years may be as follows:

1. Lumber production may grow to 33 million board feet (f.b.m.) annually with a gross product value of about 3 million dollars.

2. A small pulpmill may be in operation producing 100,000 tons of pulp annually with a gross product value of approximately 9 million dollars.

3. A preservative treatment plant will be in operation and its production together with other production of mining timbers and fuelwood will have a total value of nearly one million dollars annually.

Inventory

The inventory[a] can be summarized as follows:

1. There is a total volume of approximately 75 million cunits[b] of softwood timber of which 77% is in trees 4 to 9 inches in diameter and 23% is in trees 10 inches in diameter and larger.

2. The productive area is approximately 12 million acres which is 14% of the total area.

3. The timber is concentrated along the major river systems and 60% of the total forest resource is in the Liard River drainage in the south-east Yukon.

4. The total allowable annual cut is calculated at 1,094,000 cunits. (The present established industry uses less than 3% of this total).

Potential For Future Development

The forest inventory could sustain a large forest industry in the future.

1. The sawmilling industry could continue to grow to a total production of 50 million f.b.m. annually.

2. There are two probable sites for pulpmills which together could produce 400,000 to 600,000 tons of pulp annually.

The product value of such a future development could exceed 75 million dollars annually of which over 90% would develop from pulp and less than 10% from lumber and other products.

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a The inventory covers the detailed investigation area only but is estimated to include 90% of all of the merchantable timber in the Yukon.

b A cunit is a common measure of wood volume and equals 100 cubic feet of solid wood.

II INVENTORY OF THE FOREST RESOURCE

A. Environmental Factors Affecting Timber Growth

1. Topography

Altitude

Tree growth is greatly affected by altitude. In the southern Yukon most areas above 5, 000 feet are barren and in the central Yukon areas above 3, 000 feet are usually barren. Merchantable forests are generally limited to elevations at least 1, 000 feet below this "tree line".

North of the Ogilvie and Selwyn Mountains the territory has a general slope north-east to the Arctic Ocean. Merchantable stands in this northern area appear to be restricted to alluvial flats along the major rivers and are generally less than 500 feet above sea level.

Drainage Pattern

Most of the Territory drains west through Alaska to the Bering Sea by way of the Yukon River system (including the Porcupine River in the north which joins the Yukon River in Alaska).

Two separate parts of the Yukon drain into the Arctic Ocean. These are the drainage of the Peel River system in the north-east and the Liard River drainage in the south-east Yukon. The Liard River flows south through a portion of British Columbia before turning north-east through the Northwest Territories where it joins the MacKenzie River.

A very small area in the southwest corner of the Territory drains into the Pacific Ocean through the Alsek River.

Size of Valleys

Rivers in the southern Yukon generally have wider valleys than those in the central and northern regions and merchantable forest areas are therefore much larger in the south. The Liard River, in particular has a very wide valley and the plateau country surrounding the valley is low enough in elevation to support commercial forests.

Soil Types[1.,2.]

Unlike other northern parts of Canada, the Canadian Shield formation does not extend into the Yukon and there are no vast areas of exposed rock and swamp. Rock outcroppings are usually restricted to mountainous areas and swamp areas are small. Most of the soils are of recent glacial origin, and together with a low precipitation, this has resulted in weakly developed soils which cannot support rapid tree growth. Alluvial flats along the major rivers support better tree growth.

Permafrost conditions restrict root depth and adversely affect tree growth. In the central and northern parts of the Yukon, permafrost is common but in the southern Yukon, ares of permafrost are small and widely scattered and have practically no effect on tree growth.

2. Climate

Tree growth is greatly affected by climate. The most important climatic factors are hours of sunshine, temperature and precipitation during the growing season and length of the growing season.

The following table shows some selected climatic data for the Yukon and forest producing areas of Canada.[a]

Table 1 - Comparative Climatic Data

	Mean Annual Temp.	Mean Annual Precip.	Jan. Av. Daily Min. Temp.	July Av. Daily Max. Temp.	Frost Free Period	Growing Season[b]	May through September Sunshine Hours	May through September Total Precip.
Dryden, Ont.	34°F	25.1"	-14°F	77°F	108	163	1,095[c]	15.8"
Pr. Albert, Sask.	33	16.1	-15	76	103	165	1,182	10.9
Edson, Alta.	36	18.6	- 2	75	65	160	1,152[c]	12.7
Pr. George, B.C.	38	24.7	+ 4	73	72	166	1,164	11.4
Whitehorse, Y.T.	31	10.1	- 8	69	78	144	1,145	5.3
Watson Lake, Y.T.	27	17.0	-21	71	85	150[c]	1,175[d]	6.0

[a] Compiled from weather data supplied by the Weather Offices of the Department of Transport at Whitehorse and Prince George and by the Director of the Meteorological Branch of the Department of Transport, Toronto.

[b] Growing season is number of days with average mean temperature above 42°F.

[c] Figures estimated from data for nearby weather stations.

[d] Estimated from weather data showing relative cloud cover at Whitehorse and Watson Lake.

1. Department of Forestry and Development of Northern Affairs and National Resources, Notes on Meeting on Northern Forestry Requirements, Ottawa 1965.

2. J.S. Rowe, Forest Regions of Canada, Forestry Branch Department of Northern Affairs and National Resources, Ottawa, 1959.

The above table shows that, for tree growth, the climatic differences between the Yukon and some other forested areas are not appreciable except in terms of precipitation. Growing season as shown in the above table extends over a considerably longer period than the frost free period. This measure of growing season would not be applicable to production of agricultural crops but is the usual measure of growing season for forests.

The slow rate of growth in the Yukon compared with other areas (see table 4 page 11) results from the combined effects of soil condition and climate. From an analysis of table 1 above it would appear that the most important factors are poorly developed soils and lack of moisture during the growing season.

Climate has a second effect on development of a forest industry in that it affects the comfort and productivity of the labour force. Contrary to common belief Yukon winters are little different than those of many settled and industrialized areas in Canada. The average temperature at Whitehorse for the five month period November to March is the same as the average for Saskatoon, and is one degree warmer than Winnipeg.[1]

B. Description of Existing Forests

1. Major Forest Types

The species of trees which are most commonly found in the Yukon are as follows:

Softwood (Coniferous) Species

White spruce[a]	- Picea glauca, (Moench) Voss var. albertiana (S. Brown) Sarg.
Black spruce[a]	- Picea mariana (Mill) BSP.
Lodgepole pine	- Pinus contorta Dougl. var. latifolia Engelm.
Balsam (Alpine fir)	- Abies lasiocarpa (Hook.) Nutt.
Tamarack	- Larix laricina (Du Roi) K. Koch

Hardwood (Deciduous) Species

Black poplar	- Populus balsamifera L.
Aspen	- Populus tremuloides Michx.
White birch	- Betula papyrifera Marsh.

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1. F.H. Collins, The Yukon Territory, A Brief Presented to the Royal Commission on Canada's Economic Prospects, 1955

a White and black spruce often grow together - in this report they are referred to jointly as "spruce".

(a) Softwood Types

Alluvial Forests (mostly sawtimber)

These forests are mostly mature sawtimber stands 60 to 140 feet in height growing on flat areas along major rivers. Mixed softwood and hardwood stands are included where the softwood volume per acre is sufficiently high. The trees range from 4 inches to 30 inches in diameter with a few trees over 48 inches in diameter reported in the Beaver River area in the south-eastern Yukon. Tree heights in the central portion of the Yukon generally range up to 100 feet. Taller trees (up to 140 feet) are found in the Liard and Beaver River drainages. The main species occurring in this type are white spruce and black poplar. The spruce is often very old (ages over 300 years were noted) and the trees are limby. The spruce however, is reasonably sound and produces a fair grade of lumber. The poplar varies from good to poor quality and although the trees are of sufficiently large size to manufacture lumber, they have not been utilized to any extent.

Upland Forests

The upland forest type is subdivided into a pulpwood sized type and a young growth type.

The pulpwood type contains spruce and lodgepole pine trees 40 to 70 feet in height, generally ranging between 4 inches and 16 inches in diameter. In the northern areas the type is almost 100% spruce. In the central area the type is composed of approximately 60% spruce and 40% lodgepole pine and in the south-eastern portion of the Yukon (Liard and Beaver River drainages) the type is composed of approximately 30% spruce and 70% lodgepole pine. Trees of both species are generally young, healthy, and of good quality. The young age of this type is attributable to repeated burning of upland areas before reaching maturity. Although most of this type is best suited for pulpwood utilization, 10% or more of the area could grow stands of sawtimber size.

The young growth upland type is composed of trees less than 40 feet in height. These stands have a satisfactory stocking and are growing on sufficiently good soils to develop into merchantable stands. Most of these stands will attain only pulpwood size but a few stands in creek and river bottoms could grow to saw log size.

(b) Hardwoods

Hardwoods cover a very small part of the Yukon forest area. The hardwood stands occupy approximately 0.1% of the total area and less than 1% of the productive forest area. The main species present are black poplar, aspen, and white birch. An approximate distribution of volume between these species is as follows: black poplar 60%, aspen 25%, white birch 15%.

(c) Scrub Forest Type

The area shown as scrub on the forest cover map and in the summaries consists of low site areas which are either sparsely stocked and do not contain a merchantable volume per acre or contain trees which are very short and are not likely to reach merchantable size. Although this type does not appear to be a potential source of usable wood it covers 75% of all of the forested land and provides cover for much of the Yukon game population.

(d) Burned - not forested

This classification includes burns less than 20 years old. Older burns not reforested are classed as barren or scrub. Burns which have become reforested are classified as young growth.

(e) Barren

This type includes glaciers, mountain top, and tundra areas as well as the large flood plains along parts of the Alsek, Donjek, and White Rivers.

(f) Swamp and Water

Lakes, rivers, and open swamps make up this classification.

2. Rotation

Rotation is the cycle time between successive clear cutting of stands which results in the maximum average yearly growth of usable wood per acre.

Volume over age curves were prepared using approximately 500 sample plots taken in the Yukon by the Department of Forestry. The curves are included in this report in Appendix II.

The following table shows rotation calculated from the volume over age curves and including an allowance of 10 years for a regeneration period.

Table 2 - Rotation

Forest Type	Rotation	
	Yukon (except Liard Unit)	Liard Unit
Alluvial Forest	190 years	160 years
Upland Forest	120 years	110 years

3. Growth Rates

Growth rates for timber stands are commonly stated in terms of mean annual increment which is the volume per acre at maturity divided by the number of years required to grow the timber to maturity. The following table shows growth rates as calculated from inventory data gathered by the Department of Forestry in various parts of the Yukon. For this calculation, maturity was set at the rotation ages previously described. The development units shown in the table are used to show the regional location of the forest inventory and are shown on the Key Map and described under Section II C of this report.

Table 3 - Growth Rates

Development Unit	Forest Type	Mean Annual Increment - in cu. ft.		
		Softwood	Hardwood	Total
Klondike	Alluvial Forest	7.1	4.2	11.3
	Upland Forest	5.4	3.2	8.6
Alsek	Alluvial Forest	12.7	0.9	13.6
	Upland Forest	7.4	0.4	7.8
Teslin	Alluvial Forest	12.7	0.9	13.6
	Upland Forest	7.4	0.4	7.8
Pelly	Alluvial Forest	7.1	4.2	11.3
	Upland Forest	5.4	3.2	8.6
Liard	Alluvial Forest	16.5	2.7	19.2
	Upland Forest	15.4	1.2	16.6

4. Forest Fire Occurrence

Extremely large areas of the Yukon have been burned over during the past fifteen years. The areas shown as burned and not reforested in the area summaries and on the forest cover map are almost entirely areas burned since 1950. Burned areas which were found to be reforested during the aerial reconnaissance were reclassified as softwood, young growth. It is estimated that 25% of all the burned area is potentially productive forest land. The burned potentially productive area represents the results of an annual rate of burning of approximately 0.6%. This is about 6 times the usually accepted rate of burn for operating forest areas.

It appears that forest fires have burned over almost the entire Yukon within the last 100 years. The only mature stands of timber remaining are found on alluvial flats near major rivers where the ground was too wet for fires to occur. Repeated burning of the upland forest sites has resulted in a deterioration of soil conditions in some places and many areas which appear now to have only a scrub forest cover, could probably have supported merchantable forest stands at one time.[1]

5. Insects and Disease

A forest insect and disease survey is carried out annually in the Yukon by the Department of Forestry. Their reports indicate that the incidence of insect or disease in the Yukon is low. Most insects and diseases that are reported affect hardwood species which have no commercial importance at present.

There is some decay in the overmature spruce stands in the river bottoms, but the volume data provided by the Department of Forestry did not include any allowances for decay and all volumes shown in this report are gross volumes. It is probable however, that all of the data are sufficiently conservative that a deduction for decay would be meaningless.

6. Comparison of Yukon Forests with other Northwestern North American Forests

Coastal Alaska and British Columbia contain forests of very high quality which really cannot be compared with the Interior forests or with Yukon forests. The forests in the central portion of the Yukon are very similar to those in the interior of Alaska with

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1 D.F. Merrill, Forestry In The Yukon Territory, Yukon Forest Service, Whitehorse, undated.

the Yukon forests probably being slightly superior. The best forests in the Liard Unit are very similar to forests being presently utilized for both sawmilling and pulpwood in both British Columbia and Alberta. The best forests in the Teslin Unit are not unlike those being utilized for pulpwood in Alberta but are not as good as those being utilized in British Columbia. At present softwood species are much preferred over hardwood species for pulping and in this respect the Yukon forests, having a very small proportion of hardwood volume, might have some advantage over proposed pulpwood areas in Northern Alberta where a large proportion of the wood is in hardwood species.

The following table shows a comparison of the timber stands in the Liard and Teslin Units of the Yukon with stands being utilized in Northern Alberta and in the Prince George area in British Columbia. As a further comparison, data is also shown for stands utilized in Northern Ontario.

Table 4 - Yukon Timber Compared to Other Areas

			Utilization Standards				
Area	Vol.[a] Per Acre (cunits)	Aver.[a] Tree Size (cu.ft.)	Min. Stump. Diam. (inches)	Min. Top Diam. (inches)	Min. Vol. Per Ac. (cunits)	Growth Rate (cu.ft./ ac./yr.)	Rotation (years)
Pr.George, B.C. - pulpwood	30.0	15.0	8	4	8.0	30+	80
Hinton, Alta. - pulpwood	16.0	7.0	6	4	6.5	20.0	80
Northern Ontario - pulpwood	14.0	4.0	5	3	4.5	16.5	90
Liard Unit - sawtimber	31.0	10.2				19.2	160
- pulpwood	12.5	2.8				16.6	110
Teslin Unit - sawtimber	16.5	5.9				13.6	190
- pulpwood	11.0	3.3				7.8	120

a In comparing these figures it should be noted that the data for Prince George, Hinton, and Northern Ontario are for stands presently being utilized, whereas the Yukon data is for overall averages. The better stands in the Yukon, which would be the first to be utilized, are equal to stands presently utilized in many parts of Canada.

The effect of long rotation and slow rate of growth in the Yukon is to increase the size of the area required to supply a manufacturing plant on a perpetual basis. This will usually tend to increase log transportation costs but may be offset in the Yukon by driving logs on the major rivers.

C. Area and Volume Summaries

The following area and volume summaries refer to the southern portion of the Yukon south of the Ogilvie and Selwyn Mountains. Summaries are broken down by development units and forest types which are shown on the forest cover map. More detailed volume summaries may be found in Appendix I. A brief description of the units is as follows:

Klondike

This unit consists of the western portion of the study area. It includes the drainages of the White, Donjek, and Klondike Rivers and the lower Yukon River. Timber is restricted to isolated small patches along rivers and creeks and no major forest development is possible.

Alsek

This unit consists of the drainage of the Alsek River, which is the only drainage into the Pacific Ocean from the Yukon. Almost two-thirds of the area is barren. There is very little timber, but most of it is accessible to existing highways.

Teslin

This unit consists of the drainages of the Big Salmon, Teslin, and Nisutlin Rivers and the upper Yukon River within the Yukon Territory. Although the unit has suffered from many large fires, there is a large volume of pulp sized timber accessible to the main river systems. The rivers converge near the north end of the unit.

Pelly

This unit covers the drainages of the Pelly, MacMillan, Hess, McQuesten, and Stewart Rivers. The Pelly and MacMillan Rivers, in particular, have many alluvial flats with good stands of sawtimber.

Liard

The Liard Unit includes the drainages of the Liard, Beaver, and LaBiche Rivers and is in the extreme south-east corner of the Territory. This unit contains nearly 60% of all of the timber in the Territory.

Table 5 - Yukon Forest Resource Study - Area Summary

(Areas in 1000 acres)

Forest Type	Unit					Total All Units	Percent of Tot. Area
	Klondike	Alsek	Teslin	Pelly	Liard		
Softwood-alluvial (mostly sawtimber)	158	16	100	271	305	850	1.0
Softwood-upland (mostly pulpwood)	227	62	1,338	1,587	3,047	6,261	7.6
Softwood-upland (young growth)	151	61	1,337	1,058	2,031	4,638	5.7
Hardwood	-	-	10	48	40	98	0.1
Total Productive	536	139	2,785	2,964	5,423	11,847	14.4
Scrub	9,803	1,369	6,913	13,706	5,704	37,495	45.7
Total Forested	10,339	1,508	9,698	16,670	11,127	49,342	60.1
Burns (25% potentially productive)	1,058	24	1,867	995	818	4,762	5.8
Barren	10,802	2,887	3,847	4,712	2,822	25,070	30.6
Water and Swamp	890	156	719	663	492	2,920	3.5
TOTAL AREA	23,089	4,575	16,131	23,040	15,259	82,094	100.0

Table 6 - Yukon Forest Resource Study - Volume Summary

Units	Volumes in Cunits			
	Softwood			Hardwood
	4" to 9"	10" plus	Total 4" plus	Total 4" plus
Klondike	2,184,500	1,304,200	3,488,700	1,482,400
Alsek	559,600	199,100	758,700	46,200
Teslin	9,991,700	2,680,300	12,672,000	776,600
Pelly	9,389,800	3,872,700	13,262,500	7,113,000
Liard	35,918,100	9,483,000	45,401,100	4,447,700
Total All Units	58,043,700	17,539,300	75,583,000	13,865,900

D. Sustained Yield Capacity

Recommended initial allowable sustained annual cuts are shown in the following table by development units. The annual allowable cut was calculated by the Hanzlik Formula and checked with the Von Mantel formula. Details of these calculations are included in Appendix III of this report.

Table 7 - Recommended Allowable Annual Cut

	Softwood Allowable Annual Cut (in cunits)	
	Sawtimber (10"+) in alluvial forests	Total Cut (4"+)
Klondike Unit	8,500	30,000
Alsek Unit	1,300	9,000
Teslin Unit	10,400	195,000
Pelly Unit	19,300	150,000
Liard Unit	56,100	710,000
Total All Units	95,600	1,094,000

Volumes of hardwoods have not been included in any of the allowable cut calculations as any large scale utilization of hardwood species in this area is unlikely in the immediate future.

The above indicated allowable cut figures would permit an annual lumber production of over 52 million f.b.m. and an annual pulp production of approximately 550,000 tons of bleached sulphate pulp or 1,100,000 tons of newsprint.

Application of the current annual burn rate (0.6% of the productive forest land) to the above allowable cut figures would reduce the allowable cuts by more than 40%. Considering the timber values, topography and access in the major timber areas a reasonable annual burn rate which should be attainable with a moderate improvement in fire protection is 0.1% annually. This lower annual burn rate would result in a reduction of the indicated allowable annual cut figures by only 7%.

E. Initial Operating Areas

Any large scale sawmilling operations would first be established in the Nisutlin, Liard and MacMillan River areas. The most accessible large areas which could be logged for pulpwood are along the Teslin and Nisutlin Rivers in the Teslin Unit and along the Liard and Frances Rivers in the Liard Unit. The following tables show volumes per acre and distribution of trees by size and species for average timber types which could be operated initially for sawlogs and pulpwood. Whereas the tables portray average stands, a careful selection of cutting areas in early years of operation would enable logging to commence in stands considerably better than those indicated.

The following abbreviations are used in order to condense the size of the tables:

D.B.H.	- diameter at breast height (4.5 feet above ground).
cu. ft.	- cubic feet
ins.	- inches
S	- white spruce
Pl	- lodgepole pine
B	- balsam
Hdwd	- Hardwoods
Softwd	- Softwoods

Table 8 - Sawtimber Type - Nisultlin River

DBH (ins.)	Trees Per Acre S	Pl	B	Hdwd.	Total Softwd.	Vol. Per Acre (cu. ft.) S	Pl	B	Total Softwd.
4	58.4	2.4	4.8	4.4	65.6	58	4	4	66
5	42.9	2.5	4.5	3.3	49.9	69	6	6	81
6	38.4	3.4	2.9	4.1	44.7	101	14	8	123
7	27.7	2.9	2.1	1.8	32.7	130	17	9	156
8	21.8	1.8	2.1	1.4	25.7	148	14	12	174
9	15.7	2.0	2.0	1.6	19.7	145	20	16	181
10	10.2	0.4	1.5	0.8	12.1	139	5	18	162
11	7.9	0.9	0.7	0.6	9.5	139	14	11	164
12	5.3	0.1	0.3	0.4	5.7	116	2	6	124
13	4.1	0.2	0.1	0.5	4.4	111	4	2	117
14	1.6	0.1	0.2	0.2	1.9	51	2	5	58
15	2.4	0.1	0.1	0.1	2.6	92	3	3	98
16	0.7		0.2	0.1	0.9	31		7	38
17	0.7				0.7	36			36
18	0.2				0.2	12			12
19	0.3				0.3	21			21
20	0.3		0.1		0.4	24			24
Totals	238.6	16.8	21.6	19.3	277.0	1423	105	107	1635

Approximately 100 million f.b.m. of this type of timber is accessible along the Nisutlin River.

Table 9 - Sawtimber Type - Liard River

DBH (ins.)	Trees Per Acre S	Pl	B	Hdwd.	Total Softwd.	Vol. Per Acre (cu. ft.) S	Pl	B	Total Softwd.
4	39.0	1.8	9.3	4.3	50.1	27	1	5	33
5	35.4	3.2	9.0	6.2	47.6	64	5	15	84
6	33.7	3.9	6.0	6.2	43.6	108	13	19	140
7	31.0	1.9	2.9	5.7	35.8	161	10	15	186
8	23.8	0.7	2.1	4.5	26.6	186	5	15	206
9	22.0	0.2	1.2	3.9	23.4	238	2	12	252
10	18.5		0.7	3.4	19.2	298		10	308
11	15.4		0.4	2.5	15.8	319		7	326
12	12.3			1.9	12.3	320			320
13	9.3			0.9	9.3	296			296
14	6.6		0.2	0.5	6.8	248		6	254
15	4.5			0.5	4.5	195			195
16	2.1			0.2	2.1	107			107
17	2.1			0.2	2.1	124			124
18	2.2			0.1	2.2	152			152
19	0.5			0.2	0.5	39			39
20	0.4				0.4	36			36
21	0.2				0.2	20			20
Totals	259.0	11.7	31.8	41.2	302.5	2938	36	104	3078

At least 600 million f.b.m. of timber similar to that shown in this table is accessible along the Liard River.

Table 10 - Sawtimber Type - MacMillan River

DBH (ins.)	Trees Per Acre S	Hdwd.	Total Softwd.	Vol. Per Acre (cu. ft.) S	Total Softwd.
4	92.7	9.4	92.7	46	46
5	57.5	10.0	57.5	63	63
6	45.3	7.2	45.3	118	118
7	35.9	9.4	35.9	169	169
8	21.7	7.0	21.7	165	165
9	15.3	4.4	15.3	168	168
10	11.3	4.0	11.3	170	170
11	5.4	1.8	5.4	108	108
12	3.7	2.2	3.7	92	92
13	2.3	1.0	2.3	71	71
14	1.4	0.8	1.4	52	52
15	0.6	0.5	0.6	26	26
16	0.8	0.3	0.8	40	40
17	0.1	0.2	0.1	6	6
18					
19	0.3	0.2	0.3	22	22
20					
21					
22					
23		0.1			
Totals	294.3	58.5	294.3	1316	1316

Approximately 500 million f. b. m. of this type of timber are accessible along the MacMillan River.

2. Pulpwood Types

Initial pulp cutting operations would undoubtedly be carried out in some of the sawlog stands described above but large volume cutting operations would have to be moved into pulpwood sized stands in a few years.

Table 11 - Pulpwood Type - Teslin and Nisutlin Rivers

DBH (ins.)	Trees Per Acre S	Pl	B	Hdwd.	Total Softwd.	Vol. Per Acre (cu. ft.) S	Pl	B	Total Softwd.
4	64.5	68.3	3.8	8.6	136.6	52	109	3	164
5	40.6	46.5	2.7	4.2	89.8	53	121	4	178
6	30.2	28.0	1.4	3.2	59.6	81	105	4	190
7	16.6	12.1	1.2	1.5	29.9	68	70	5	143
8	12.8	5.5	0.8	0.4	19.1	76	43	5	124
9	6.3	1.7	0.4	0.2	8.4	51	17	3	71
10	4.1	0.7	0.4	0.2	5.2	49	9	5	63
11	2.4	0.4	0.1	0.2	2.9	37	6	2	45
12	1.7	0.3		0.1	2.0	32	6		38
13	1.2	0.1			1.3	27	2		29
14	0.3				0.3	8			8
15	0.4				0.4	13			13
16	0.2				0.2	7			7
Totals	181.3	163.6	10.8	48.6	355.7	554	488	31	1073

Approximately 5 million cunits of timber of this type are available along the Teslin and Nisutlin Rivers. Since the average age of this type is 100 years and a rotation of 120 years is indicated, initial logging could be confined to the older and better parts of the type and the lower volume stands allowed to grow.

Table 12 - Pulpwood Type - Liard River

DBH (ins.)	Trees Per Acre				Vol. Per Acre (cu.ft.)		
	S	Pl	Hdwd.	Total Softwd.	S	Pl	Total Softwd
4	90.6	91.0	14.4	181.6	45	46	91
5	58.2	53.5	9.1	111.7	99	91	190
6	38.3	28.7	8.2	67.0	122	92	214
7	23.1	12.2	4.2	35.3	118	62	180
8	13.7	6.2	4.2	19.9	101	46	147
9	9.4	3.3	1.3	12.7	97	34	131
10	5.7	1.7	0.8	7.4	79	24	103
11	3.0	1.3	0.6	4.3	53	23	76
12	2.0	0.3		2.3	44	7	51
13	0.7		0.1	0.7	18		18
14	0.7		0.1	0.7	21		21
15	0.2			0.2	7		7
16							
17	0.1			0.1	5		5
Totals	245.7	198.2	43.0	443.9	809	425	1234

Approximately 10 million cunits of this type of timber are accessible along the Liard River. The average age of this type is only 80 years and considerable growth could be expected if initial logging was confined to areas in the general type where timber is older and has a higher volume per acre.

F. Forest Cover Map

A forest cover map at a scale of 16 miles to one inch is appended to this report.

The following items are shown on the map:

Forest cover types
- softwood
  - alluvial (sawtimber)
  - upland (pulpwood and young growth)
- hardwood
- recent burns not satisfactorily restocked
- scrub
- barren
- swamp

Topographic features	- creeks - rivers - lakes
Improvements	- cities and towns - roads - railroad
Proposed development	- development units - manufacturing plant sites - required access road development

III. HISTORICAL REVIEW

A. Development of the Existing Industry

The development of the forest industry in the Yukon has depended largely on the state of the mining industry. When Dawson City was bursting with nearly 20,000 people, in the summer of 1898, there was a tremendous demand for lumber. Twelve sawmills are reported to have produced about 12 million f.b.m. for construction in Dawson that summer.[1] This kind of production has not been repeated in the Yukon since. Lumber was required during the gold mining boom for construction of buildings and for flumes and sluice boxes. Large quantities of wood were also consumed for fuel. Records indicate that during the peak of the boom at Dawson (1898-1899) permits for cutting 1,000 cords or more were issued almost daily. The stern-wheeled steamers which plied the Yukon for many years were fired with cordwood and it is estimated that a total of 300,000 cords were cut along the banks of the river for these boats.[2]

Most of the good timber near Dawson City had been cut by 1930 and the sawmill industry in the Yukon was almost eliminated. Most of the lumber used in the Yukon was imported from British Columbia until 1940. During the second world war large quantities of lumber, timber, and fuelwood were cut for military purposes.

The sawmill industry has continued to expand slowly since World War II and there are presently 10 sawmills in the Yukon with a combined capacity of about 7 million f.b.m. per year. Production of fuelwood and mining timbers has remained fairly constant, mainly because large quantities of mining timbers are used in the underground mining operations of United Keno Hill Mine Ltd. at Keno and Elsa.

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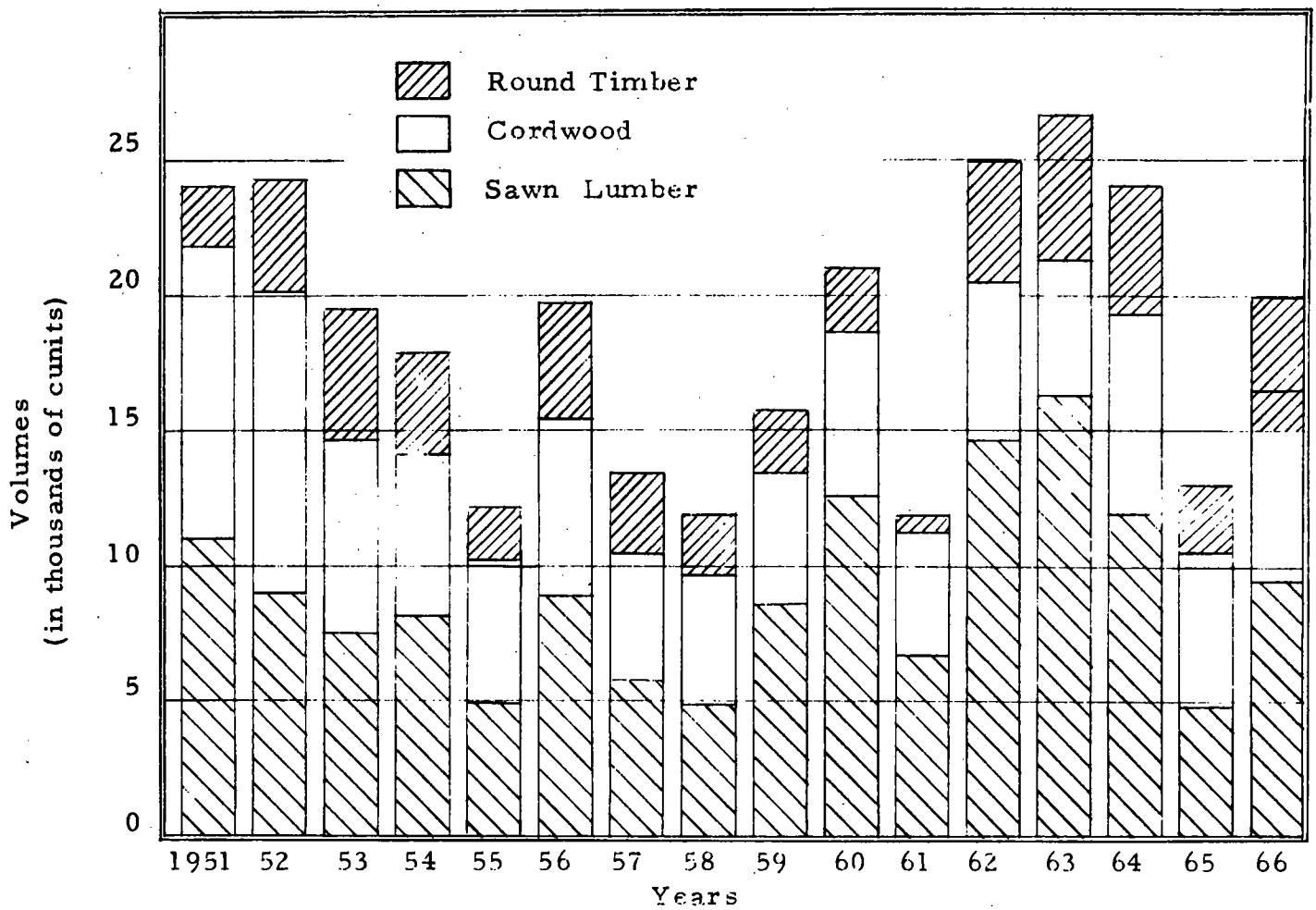
1 P. Berton, Klondike, McClelland and Stewart Limited, Toronto, 1958.

2 D.F. Merrill, Lumbering In The Yukon Territory, Department of Northern Affairs and National Resources, Whitehorse, 1961.

The following graph shows the annual production of various forest products since 1951:

Figure 1 - Yukon Forest Products Production[a]



B. Local Demand for Forest Products

Substantial quantities of lumber are imported each year from British Columbia in order to meet the local demand. This is partly because of unavailability of locally produced lumber and partly because of the superior manufacture of the imported lumber. Larger, and better financed, local producers could manufacture lumber equal to most of that presently imported.

a Based on figures supplied by the Yukon Forest Service with the following conversion factors used:

Lumber - 1.8 cunits per M f.b.m.
Cordwood - 0.85 cunits per cord.
Round Timber - 0.002 cunits per lineal foot.

The demand for lumber is increasing rapidly with increases in population and a demand for a better standard of housing in the Yukon. It is estimated that the current total Yukon lumber consumption is about 10 million f.b.m. per year (or about 600 f.b.m. per capita). The national average per capita lumber consumption is 200 f.b.m. per year (based on 1961 data).

Fuelwood demand has dropped from 20,000 cords or more annually in peak years to about 8,000 cords annually at present. This represents a slight decline in per capita consumption over the past 15 years and the present consumption is about 35 cubic feet per capita. The decline is due to concentration of the population in major centers where oil heating is more common.

The demand for mining timbers has been mainly from United Keno Hill Mines Ltd. This company used almost one million lineal feet in 1966 and only slightly less in 1967. This represented 60% of all round timber used in the Territory. (An analysis of timber usage at United Keno Hill Mines Ltd. during 1966 and 1967 indicates that their underground mining operation consumes 5.4 cu.ft. of round timbers and 3.4 cu.ft. of logs converted into lumber, per ton of ore milled).

Plywood, wallboards, and pulp and paper products have been completely supplied from imports as they are not manufactured within the Territory.

C. Factors Which Have Restricted Growth of the Industry

1. Size of Market

The local market for forest products has not been large enough to support a modern and efficient manufacturing plant. The current rapidly increasing demand for lumber should encourage establishment of a more permanent sawmilling industry.

2. Quality of Timber

Although some excellent timber can be found in isolated locations in the Yukon, the average timber stands are inferior to those that have been available in British Columbia and Alberta, or Coastal Alaska. The best timber stands in these other areas are now fully committed and opportunities for expansion are becoming more limited.

3. Access

Some of the best stands of sawtimber in the Yukon have not been utilized because they are in remote areas and a small lumber industry could not absorb the access road costs involved. Roads being developed for new mines and exploration will provide the needed access to much of this timber.

4. Costs

The high cost of operating a manufacturing plant in the Yukon tends to offset the freight cost advantage local lumber has over imported lumber. Currently, freight on imported lumber is approximately $50 per M f.b.m.[1] which is almost 80% of the value of lumber produced at most B.C. mills. An efficient mill should be able to operate under the more expensive Yukon conditions and show a reasonable profit if this freight rate is maintained on imported lumber.

IV. INDUSTRIAL DEVELOPMENT

A. Short Term (15 years)

1. Lumber Production

Local Market

The Yukon should be self-supporting in most of its lumber requirements. The local market for lumber will expand rapidly with the development of new mines and communities.

The following graph shows the expected growth in the Yukon lumber demand and the projected lumber production. The present per capita consumption of lumber in the Yukon is approximately 600 f.b.m. per year compared with the national average of approximately 200 f.b.m. per year[2] (both of these consumption figures have remained fairly constant during the past 15 years, but due to a probable decline in underground mining a gradual reduction to 500 f.b.m. per capita per year is probable in the Yukon consumption by 1980).

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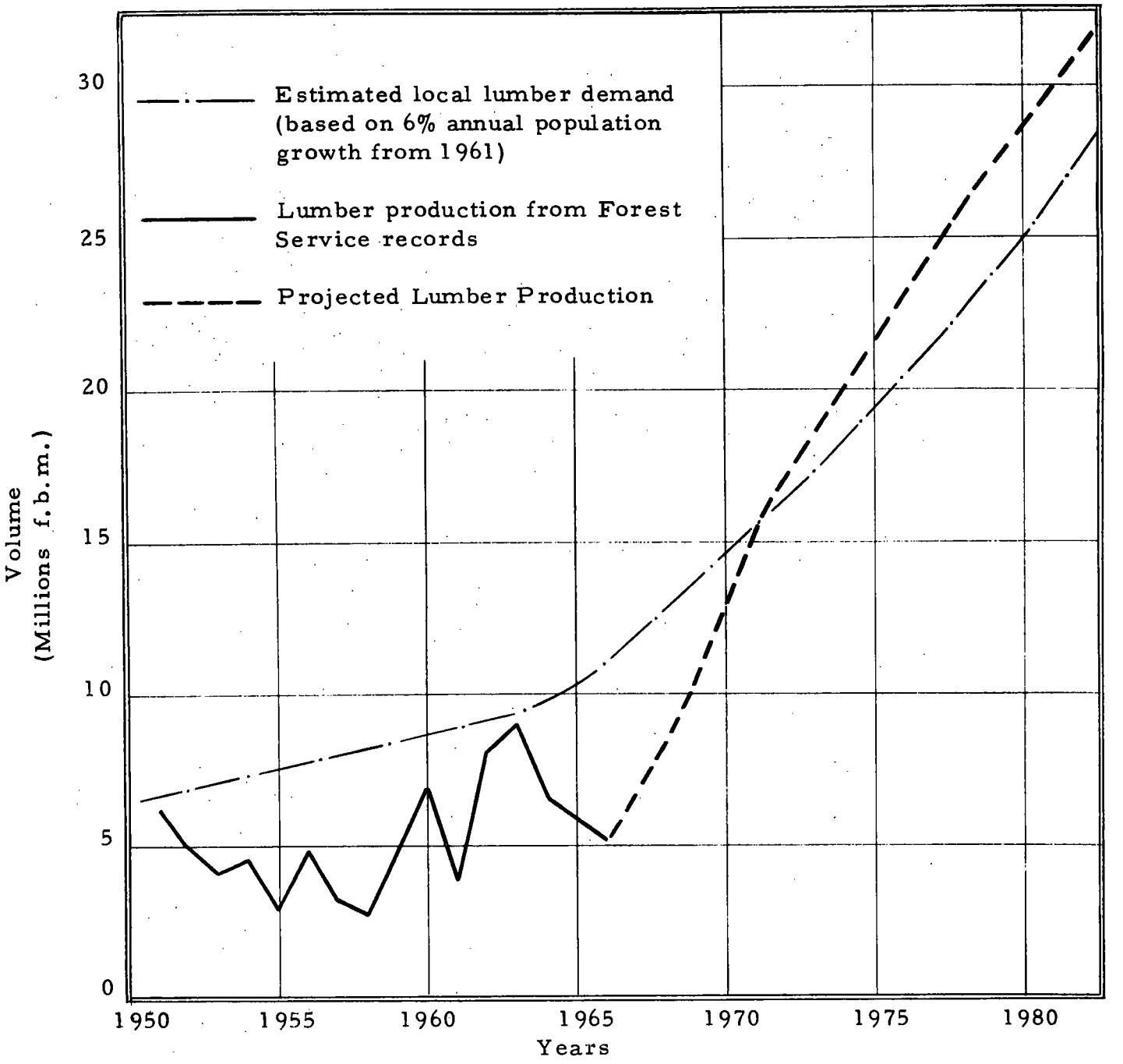
1 White Pass and Yukon Route, Freight Tariff.

2 I Mahood, and F.L.C. Reed, Canada's Place in World Markets for Lumber and Plywood in 1975 and 2000, Background Paper, National Forestry Conference, Montebello, P.Q., Feb. 1966.

Figure 2 - Projected Yukon Lumber Industry



Lumber Export

Major lumber export will not be feasible as transportation costs and operating costs will be too high to permit competition with lumber producing areas in British Columbia. The slight over-production shown in the above graph after 1971 would be exported into neighboring small communities in Alaska and extreme northern British Columbia.

Sawmill Industry 1983

It is expected that the sawmilling industry will grow to produce a total of 33 million f.b.m. annually by 1983 with production distributed as follows:

- 20 million f.b.m. will be produced annually in the Liard River area north of Watson Lake by one or two sawmills. (One mill is operating in the area at present and a second larger operation is planned).

- 5 to 8 million f.b.m. will be produced annually in the MacMillan and Pelly River area by one or two mills.

- 2 to 3 million f.b.m. will be produced annually in the Nisutlin River area by one mill.

- 3 to 5 million f.b.m. will be produced annually by up to 10 small sawmills scattered over the rest of the Territory (Although the best timber stands appear to be in the Macmillan, Pelly, Liard, and Nisutlin River valleys, mills will be able to operate in small blocks of poorer timber where they can find them close to areas where the demand develops).

2. Pulp Production

Review of World Demand

The Food and Agricultural Organization of the United Nations has forecast a 4.7% annual increase in the total world use of wood fibre.[1] This amounts to an increase over 1967 levels of 90% by 1983 and nearly 300% by 2000. In 1959 Canada produced 18% of the total world production and Canada together with the Scandinavian countries supplied nearly 90% of the pulp and paper products which entered international trade. Traditionally the Scandinavian countries have supplied most of the European imports and Canada has supplied most of the United States imports.

As a result of a race to secure timber supplies for the future, large numbers of mills have been constructed and many more are planned. This increase in capacity has come at a time when the usual increase in the United States market has not materialized because of increased production within the United States.

Demand is expected to catch up to supply sometime in the early 1970's and in the meantime new mills being built are usually based on definite market commitments from organizations in Europe or Japan and these organizations are participating in the financing of the mills.

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[1] D.A. Wilson, Demand Prospects for Forest Products. Resources for Tomorrow Conference Background Paper, Ottawa: Queen's Printer, 1961.

A growing market for wood fibre is developing in Japan. Japanese per capita consumption in 1966 was 175 pounds compared with 60 pounds in 1956. (This is still well below the Canadian average of 300 pounds and is likely to continue to grow as Japanese living standards rise). The Japanese are importing wood chips from the West Coast of North America (special chip carrying ships are being constructed), logs from Russia, and are investigating uses of tropical broadleafed trees for pulp. Japanese wood pulp imports in 1966 were approximately 740,000 tons (an increase of more than 30% over 1965).

The National Forestry Conference which convened in Montebello, Quebec in February 1966,[1] reviewed the demand for Canada's forest resources to 2000. It concluded that the demand for wood supplies for pulp and paper alone would rise from 17 million cunits in 1966 to 27 million cunits in 1975 and to 92 million cunits by 2000.

The conference also agreed that the total wood requirements for all forest products would rise from 34 million cunits in 1965 to 51 million cunits in 1975 and to 140 million cunits in 2000. Reported accessible wood resources were expected to be sufficient to meet the demand to 1975 but would not be sufficient to meet the demand in 2000. The shortage can only be met by improved forest practice on accessible areas and by improved technology which will permit economical operation in areas presently considered inaccessible.

In view of the large increases forecast in demand for wood fibre, both in Canada and around the world, the long term future development of the Yukon's forests is assured.

Yukon Advantages and Disadvantages

In order for development to take place, the Yukon forests must possess an advantage over other available supplies. Eventually, the necessary advantage would be provided by other supplies being unavailable. On a short term outlook, the Yukon forests have some specific advantages and disadvantages which will govern the manner in which they are developed. These advantages and disadvantages are as follows:

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1 Department of Forestry, National Forestry Conference Summaries and Conclusions, Ottawa, 1966.

(a) Advantages

1. The forests contain a high proportion of softwoods of the most desired species for production of high quality pulp.

2. The timber is concentrated along navigable rivers.

3. The climate is conducive to economical all-season logging.

4. There is a large potential for hydro-electric power which might be developed economically with increased industrialization and resulting power demand.

5. Possible pulp mill sites are located relatively close to the Pacific Ocean and are thus close to a rapidly expanding market for wood pulp in Japan.

(b) Disadvantages

1. Although potential pulp mill sites are close to ice-free Pacific Ocean ports, neither the ports, nor the land transportation facilities to them, are sufficiently developed to permit economical importing of required materials and exporting of pulp.

2. Attraction of a good labour force will be hindered by the relative isolation of the Yukon communities and a common belief that the winter is very severe.

3. The forest stands contain low volumes per acre compared to the better stands in the interior of British Columbia and other nearby producing areas.

4. Trees are of small size.

5. Growth is slow and rotation is long resulting in large areas being required for a sustained supply.

6. The cost of operating equipment is high - this may be due to the lack of an economical transportation system.

Possible Types of Pulp Industry

A pulp development in the Yukon could take several forms such as:

(a) Production of bleached kraft pulp - this is the product of most mills established in the last 10 years.

(b) Production of newsprint - this is a combination of groundwood and chemical pulp and the type of timber available in the Yukon is well suited to this product.

(c) Production of refiner groundwood pulp - several such developments are proposed in British Columbia by Japanese interests. The product is a long fibre pulp which could be baled for export to Japan where it would form part of the furnish for newsprint or other papers.

(d) Export of pulp chips to Japanese or Alaskan pulp mills.

(e) Export of pulpwood in log form to Japanese or Alaskan pulp mills.

Export of chips or logs would have to be considered as a temporary measure only, until the economics became favourable for the construction of a pulp mill within the Yukon.

Pulp Development by 1983

Considerations of the above described five possible pulp industries are outlined in Appendix IV. It appears that the most probable development in the next 15 years is construction of a refiner groundwood plant for production of dry baled pulp for the Japanese market.

This development would depend on:

(a) Availability of power at an effective rate of 5 mills or less (1 mill adds $2.00 per ton to the cost of production).

(b) A transportation system which could move pulp to a coastal port for not more than $8.00 per ton. Present trucking costs of about 5 cents per ton per mile would indicate that only rail transport could operate on this freight rate. Quoted rates in British Columbia, for transport of pulp by rail over comparable distances to the distance from Carmacks to the coast, are between $6.00 and $7.00 per ton.

The development would have to take place near Carmacks or near Watson Lake to take advantage of the natural waterways for log transport. If mineral development could warrant construction of a railroad close to the proposed site near Carmacks a pulp mill could contribute 100,000 to 150,000 tons of freight traffic annually.

A pulp mill would not likely begin production before 1980 but construction could begin about 1978. The mill would probably begin production at about 300 tons per day with provision for eventual expansion to 500 or 600 tons per day.

3. Other Forest Products

Other forest products include plywood, fuelwood and roundwood products.

(a) Plywood

The timber in the Yukon is not well suited to production of plywood due to the small sizes and numerous limbs. The population (and the local plywood demand) will probably not grow sufficiently in the next 15 years to justify any investment in a plywood plant. Improved transportation systems should reduce the freight cost on imported plywood.

(b) Roundwood Products

These products include mostly mining timbers and some building logs at present but could include power and telephone poles in future. Most new mines will probably be of the open pit type and will not require the large volume of timber that has been used in underground mining (particularly at the United Keno Hill Mine). It is estimated that the increase in timber used for power and telephone lines will more than offset any decrease in the use of mining timbers and that the total demand for roundwood products will rise at a rate of about 3% annually for the next 15 years. A preservative treatment plant for poles is presently under consideration by a developer in the Watson Lake area and such a plant is likely to be in operation by 1975.

B. Long Term Development

1. Lumber Production

Local lumber production should continue to supply the demand for construction lumber until the demand exceeds 50 million f.b.m. annually. (This would happen when the population approached 200,000 which is unlikely to occur before 2000.) Improvements in transportation systems between the Yukon and Coastal British Columbia will permit economical importing of high quality finishing lumber but construction lumber should be cheaper to produce in the Yukon.

2. Pulp Production

Eventually, two pulpmill sites might be developed in the Yukon.

The first site to be developed will probably be on the Yukon River, either at a point about 20 miles east of Carmacks or near Fort Selkirk at the mouth of the Pelly River.

The second site is on the Liard River near Watson Lake. Although there is more timber of better quality at this second site it appears that development of a transportation system which will provide economical movement of materials to and from the coast is more probable in the Carmacks area in the near future.

The location of the proposed pulpmill sites are shown on the forest cover map together with the roads which would have to be constructed to provide access for logging.

Although a refiner groundwood pulpmill is most probable at the Yukon River site initially, eventual addition of, or conversion to, a bleached kraft pulpmill would be of benefit to the Yukon economy.

The requirements for these two pulpmill sites are as follows:

Table 13 - Potential Pulpmills

	Yukon River	Liard River
Type of pulpmill	Bleached Kraft	Bleached Kraft
Size of pulpmill	500 tons/day[a] (possible expansion to 750 tons/day on timber resource available)	750 tons/day (possible expansion to 1000 tons/day on timber resource available)
Approx. Investment (incl. working capital)	$60,000,000	$80,000,000
Labour required-mill	360	450
-woods	320	400
Annual payroll	$ 5,500,000	$ 7,000,000
Annual pulpwood required	280,000 cunits	450,000 cunits
Water required	36 cu. ft./sec.	54 cu. ft./sec.
Power required	15,500 kw.	24,000 kw.
Fuel required	500 barrels fuel oil/day or 2.9 billion BTU's/day	750 barrels fuel oil/day or 4.3 billion BTU's/day
Annual Transportation		
- Pulp tonnage shipped	170,000 tons	250,000 tons
- Fuel and Chemicals from Coast	85,000 tons	120,000 tons

a A production of 500 tons/day can be supported by the Teslin unit plus the Pelly and MacMillan River drainages of the Pelly unit or by the Teslin unit and part of the volume available in the B.C. portion of the Yukon and Teslin River drainages. An expanded production of 750 tons per day would require the timber from the Teslin unit, the Pelly and MacMillan drainages of the Pelly unit and all of the timber available in the B.C. portions of the Yukon and Teslin River drainages. (The annual volume available in B.C. is estimated at 180,000 cunits).

3. Other Forest Products

(a) Plywood

When the population of the Yukon approaches 100,000 persons (which could occur between 1990 and 2000) local demand might be sufficient to warrant investment in a small plant to produce sheathing grade plywood. A plywood plant would have to be integrated with a pulpmill or sawmill in order to obtain logs of the size and quality necessary. The wood requirements of a small plywood plant would not exceed 3,000 cunits annually.

(b) Fuelwood

No change is likely in the fuelwood consumption. As wood for heating is replaced by other fuels, homes with fireplaces in the larger centres will require equivalent volumes of wood. A population of 100,000 persons largely concentrated in a few modern communities could result in a demand for up to 5,000 cunits annually of fireplace wood.

(c) Roundwood Products

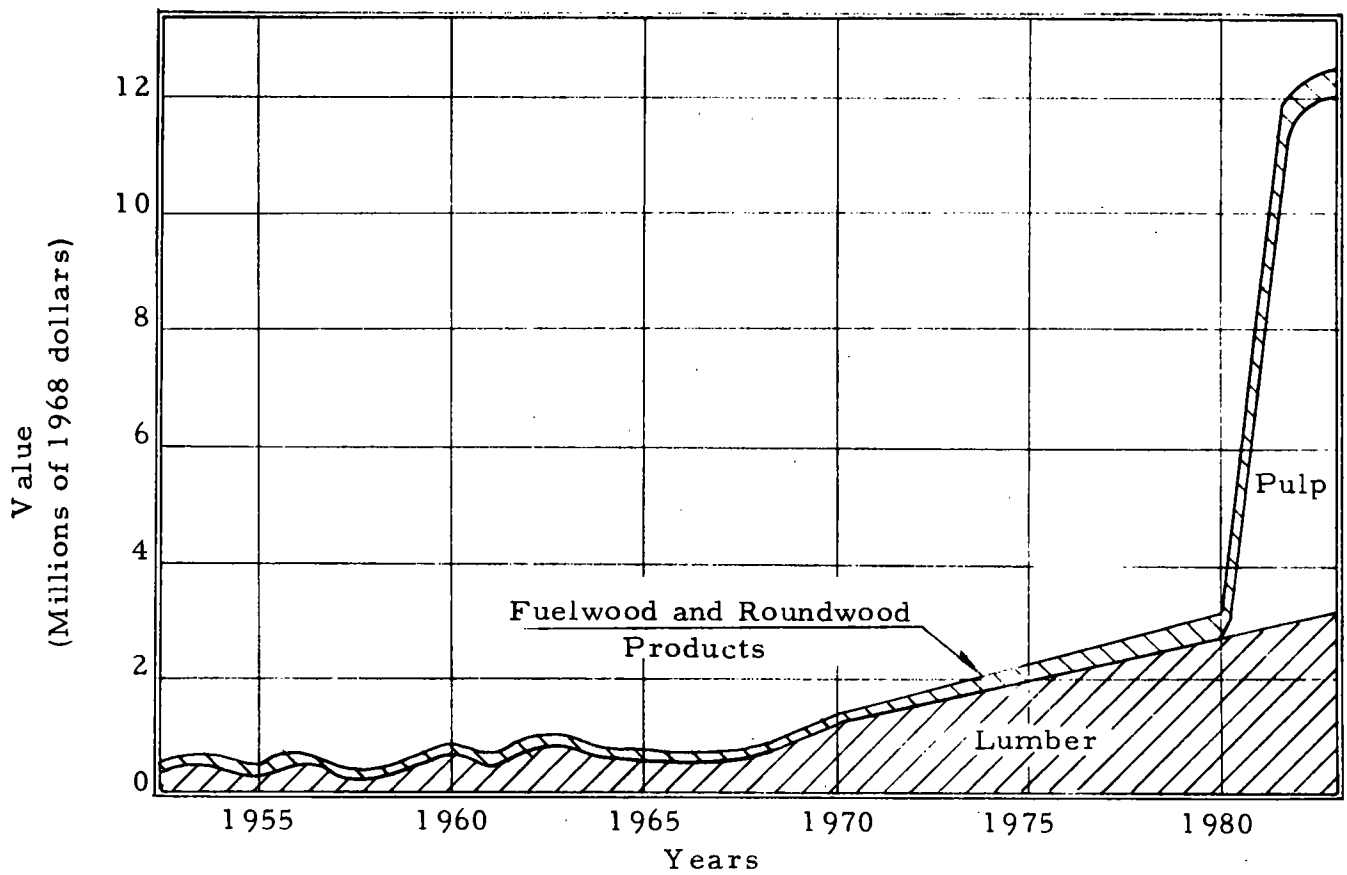
The demand for roundwood products will probably continue to rise as long as the Yukon economy is expanding. The demand will be mainly for preservative treated products and the best source of supply for a preservative treatment plant appears to be in the Watson Lake area. It is unlikely that more than one treatment plant in the Yukon would be profitable.

V. CONTRIBUTION OF THE FOREST INDUSTRY TO THE YUKON ECONOMY

A. Value of Forest Products

The growth in value of products produced (including transportation of finished product to coastal shipping point or to local market) is indicated in the following graph. Current unit values of products are used.

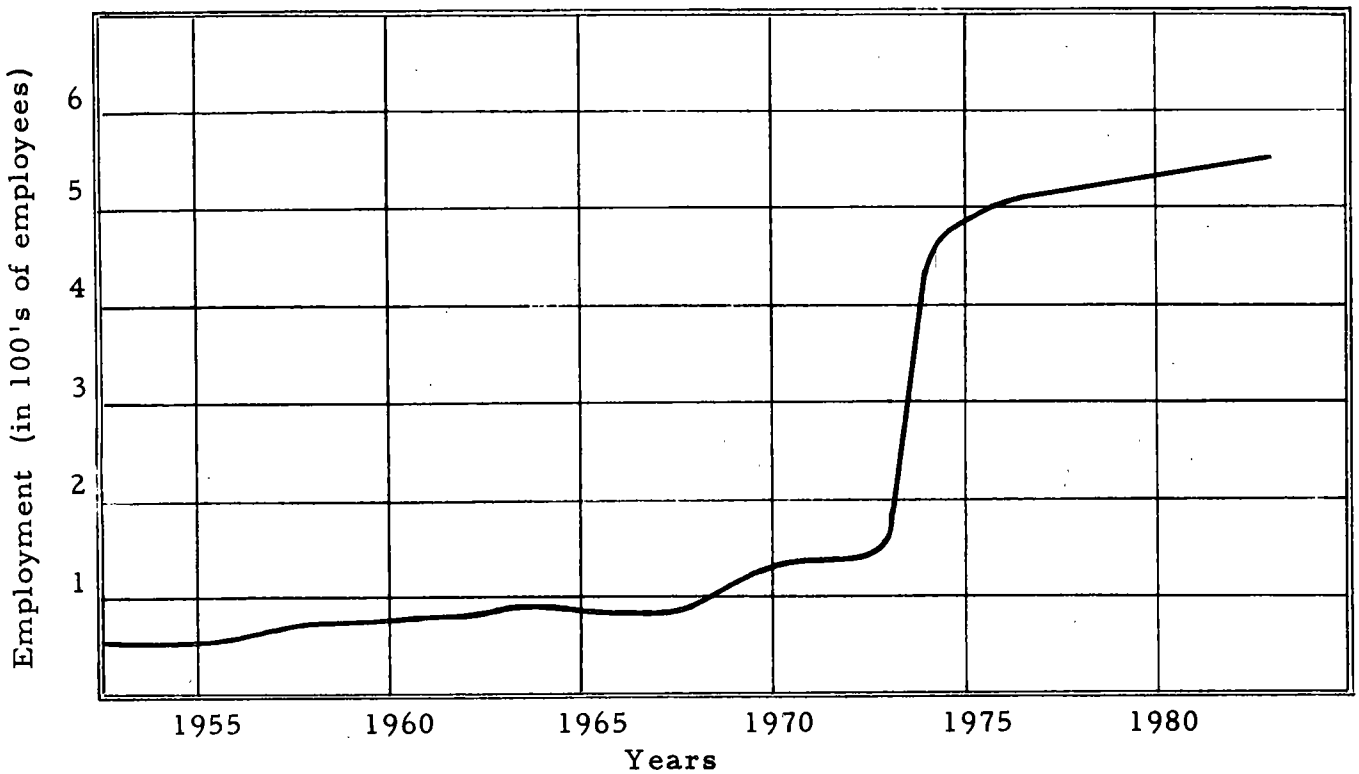
Figure 3 - Value of Forest Products Produced



B. Employment

The following graph shows numbers of employees in all branches of the forest industry and includes workers on construction of manufacturing plants.

Figure 4 - Employment in Forest Products Industries (does not include retailing forest products - but does include Yukon Forest Service personnel)



C. Employee Earnings

Assuming wages in the Yukon continue to be similar to those in British Columbia, the total earnings of employees in the forest industry are estimated to be as follows:

Year	Estimated Employees	Estimated Total Annual Earnings
1951	57	280, 000
1961	79	450, 000
1966	83	500, 000
1970	125	800, 000
1975	490	3, 500, 000
1980	535	4, 200, 000
1983	545	4, 600, 000

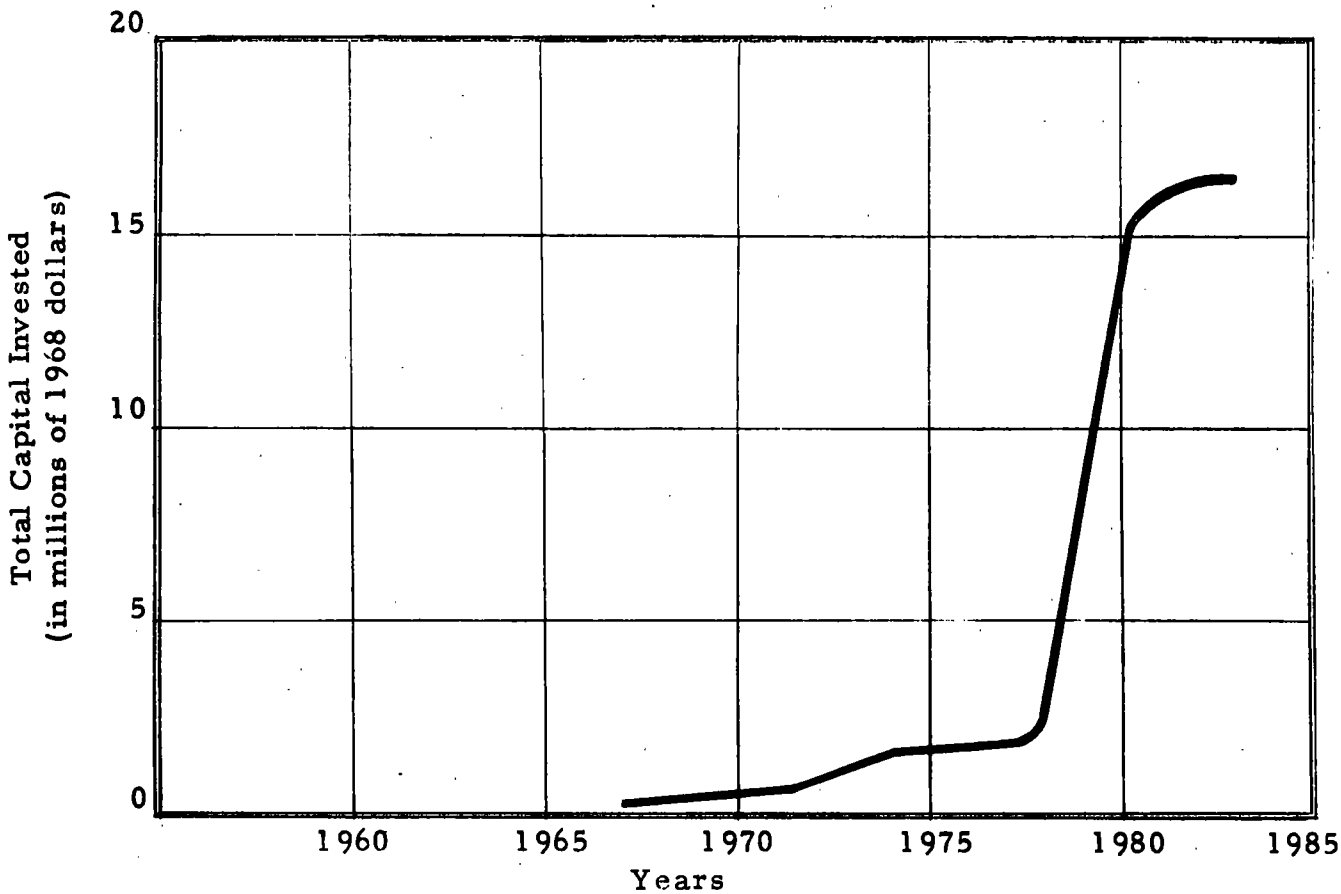
These figures are in terms of 1968 dollars and make no allowance for inflation. They include salaries of the Yukon Forest Service permanent staff.

VI. DEMANDS OF THE FOREST INDUSTRY ON THE YUKON ECONOMY

A. Capital Investment

The following graph illustrates the anticipated growth in total capital invested in the forest industry in the Yukon in 1968 dollars.

Figure 5 - Capital Investment in Yukon Forest Products Manufacturing Plants and Equipment



The main items contributing to the growth in investment are:

1. Continuous modernizing and enlarging the main sawmills from 1968 to 1983.

2. Construction of a preservative treatment plant in the Liard River area between 1970 and 1975.

3. Construction of a pulpmill between 1975 and 1983.

B. Electric Power Requirements

Small sawmills will probably generate sufficient electric power for their own requirements. Two of the largest sawmills might be located where hydro-power could be delivered to them economically in which case they could require up to 1, 000 kilowatts in total (possible 600 kilowatts near Watson Lake and 400 kilowatts near Pelly Crossing).

Electric power requirements for a preservative treatment plant are relatively light and it is estimated that 1000 kilowatts might be required. Such a plant might or might not be located where power could be delivered to it economically.

A refiner groundwood pulpmill such as that proposed in this report would require about 1800 kilowatt hours per ton of pulp for a total demand of 20, 000 to 25, 000 kilowatts.

On the basis of the above assumptions, total electric power demand for the forest industry is estimated as follows:

1970 - Nil
1975 - 2000 kilowatts
1980 - 25000 kilowatts
1983 - 27000 kilowatts

C. Transportation Requirements

Transportation of logs, lumber and round timber products is included with the forest products operations. The major transportation requirement would be moving pulp to the coast for overseas shipment. This would amount to about 100, 000 tons annually for the refiner groundwood mill suggested. In addition there would be 20, 000 to 30, 000 tons of fuel and other materials to be transported from the seaport to the pulpmill annually. As stated previously in this report the freight cost could not exceed $8.00 per ton for economical operation of a pulpmill.

D. Other Services

Communities would have to be developed around the proposed preservative treatment plant and the pulpmill. A pulpmill, of the size and type considered most probable, would support a community of about 2000 to 3000 persons.

VII. OTHER LAND USE

A. Parks

The tourist industry is expected to be one of the major industries in the Yukon. One of the main appeals to the tourists is that the country is "wild" and untouched. It will be essential to provide park areas where no logging operations take place. These areas can be chosen, however, so as not to reduce the productivity of the forests significantly. Major "wilderness" areas should be restricted to the south-western portion of the Yukon where timber values are negligible and the scenery is best. In the areas where forests are developed, proper forest management will result in a gradual improvement in the appearance (and productivity) of the forest. Logging access roads will provide additional access for tourists and will permit more rapid attacks on forest fires.

The following steps are recommended to permit the maximum "multiple use" of the Yukon forests:

1. Locate any wilderness parks in the south-west part of the Territory or north of 64° N. Latitude.

2. Continue the program of developing small campsite parks along main highways to minimize the danger of forest fires caused by tourist campfires.

3. Reserve from logging a narrow strip (one-eighth of a mile wide at most) of timber along main highways and shorelines of large lakes.

4. Permit tourist traffic on all main access roads constructed for logging but do not allow entry to active logging areas, logging campsites, etc. Small campsite parks could be constructed along logging access roads to keep the tourists from camping "in the bush" as much as possible.

5. Since lakes and rivers will be used for transporting wood to manufacturing plants it will be necessary to restrict boat traffic on some rivers for short periods to facilitate log driving.

B. Hydro-Electric Power Development

The pulpmills which are expected to be eventually established in the Yukon will require more than 40,000 kilowatts of power.

A large number of potential hydro-electric power developments have been investigated for the Yukon River system. Proposed power developments include dams on the Yukon and main tributary rivers and flooding of large areas behind the storage dams. Reservoir lakes thus created could be of benefit to a major forest products industry for log storage and movement, provided the flooding did not eliminate the main timber supply.

As can be seen from the Forest Cover Map most of the productive forest land is in the valleys of the major rivers, and would be seriously affected by flooding for power developments. The effect of this flooding may be minimized by developing the hydro-sties which will involve the smallest loss of productive forest land. There appears to be more than an adequate potential for hydro-power for the foreseeable future and some selection of sites for development must be made. The effect on forest land should be a consideration in this selection.

The following table shows the approximate effect on productive forest land from the most recently recommended Yukon River power development scheme.[1.,2.] The "Modified System Plan" is a system of development on the lower part of the Yukon River which can operate concurrently with the diversion of the upper part of the Yukon to the Pacific Ocean. Proposed dam sites for this plan are shown on a map in Appendix V.

1. H.T. Ramsden, Potential Hydro Power Resources of the Yukon, Northern Resources Conference, Whitehorse, Y.T., March, 1963.

2. Position Paper (Confidential) - Power Development on the Yukon River, Department of Northern Affairs and National Resources, October, 1965.

Table 14 - Effect of Hydro Reservoirs on Forest Potential

	Dam Height (ft.)	Power Potential (megawatts)	Area to[a] be flooded (acres)	Forest Land Flooded (acres)	Timber Volume Flooded (cunits)
"Modified System Plan"					
Yukon River (Main Stem)					
- Britannia	220	160	14,000	2,000	10,000
- Ogilvie	250	370	42,000	19,000	150,000
- Dawson	140	290	9,000	5,000	60,000
- Boundary	240	520	25,000	12,000	80,000
Pelly River					
- Detour	210	-	38,000	18,000	140,000
- Granite Canyon	325	170	95,000	93,000	650,000
- Bradens Canyon	220	120	34,000	13,000	90,000
Stewart River					
- Fraser Falls	290	230	90,000	29,000	250,000
- Independence	350	290	117,000	52,000	330,000
- Porcupine	180	150	14,000	6,000	60,000
Total "Modified System Plan"		2,300	478,000	229,000	1,820,000
Diversion Plan[b]					
- Yukon-Taiya Diversion		2,880	110,000[c]	80,000	790,000
- or Yukon-Taku Diversion		2,410			

a Areas estimated from forest cover and topographic maps and are not necessarily exact but serve to show the relative difference in loss of timber values due to various projects.

b Only one of the two diversion plans can be developed. A key map is included in the appendix to show the locations of the proposed hydro-electric power developments tabulated above.

c The total flooded area is 170,000 acres, but figures shown in this table are for the Yukon portion only.

Several important considerations are illustrated in the above table.

1. Productive forest land comprises 48% of the total area to be flooded by the "Modified System Plan" and 72% of the area to be flooded by the Diversion Plan. This is in sharp contrast to the total area covered by the inventory of which only 14% is productive forest land.

2. The system of dams on the Stuart and Pelly Rivers would inundate at least one-third of the sawtimber existing in these river valleys.

3. The area flooded and timber values lost are much less for the Diversion Plan than for the "Modified System Plan".

4. Within the "Modified System Plan" there is a possibility of selecting for first development, the sites which would involve the least flooding and damage to timber.

5. The proposed flooding would reduce the annual allowable cut (by removing forest land from production) by 13,000 cunits for the "Modified System Plan" and a further 6,000 cunits for the Diversion Plan.

All of the above discussion has related to power development on the Yukon River only. In the far north of the Territory the Porcupine and Peel River systems could provide additional hydro-power with less damage to timber. (Sites on these rivers are probably too far from any demand to be developed for many years).

The British Columbia Government has investigated power development on the Liard River. This may not involve any flooding within the Yukon Territory, but, since the valley of the Liard River is very wide and is well timbered, any large scale power development on this river in the Yukon would significantly reduce the forest potential of the area.

VIII. PROVINCIAL AND INTERNATIONAL BOUNDARIES

The Yukon's southern and western boundaries create a number of problems for industrial development as they are not related to the topography. As a result, interprovincial and international agreements will be necessary to promote maximum development of the northern resources.

A. British Columbia Boundary

The forest resource in the Liard River valley extends southward into British Columbia and eastward and eventually north into the Northwest Territories. Although there appears to be enough timber in the Yukon portion of the drainage to supply a large scale pulp development, it is possible that a giant enterprise involving timber from both sides of the border could be more economical. It is probable that such an enterprise would have the main manufacturing plant located downstream in British Columbia.

The Yukon and Teslin River drainages originate in British Columbia and flow north into the Yukon. There is a large volume of timber in these drainages which could be utilized to augment the supply for a pulpmill in the Yukon. The large lakes and easily navigable rivers should permit economical movement of logs into the Yukon.

The following tables show areas and volumes available in these drainages.[1]

Table 15 - Area Summary - Yukon and Teslin Drainages in B. C.

Classification of Area	Area in Acres	Percent of Total Area
Mature timber	738,000	12.4%
Immature timber	912,000	15.3%
Scrub and Barren (incl. burn-not reforested)	3,690,000	62.0%
Swamp and Water	611,000	10.3%
Total	5,951,000	100.0%

1 From B.C. Forest Service, Forest Inventory Summaries, Maps and Summaries, 1958.

Table 16 - Volume Summary - Yukon and Teslin Drainages in B.C.

	Volumes in cunits			
	Softwood			Hardwood
	4" to 9"	10" plus		4" plus
Mature Timber	4, 201, 000	19, 577, 000	23, 778, 000	925, 000
Immature Timber	6, 468, 000	7, 779, 000	14, 247, 000	3, 784, 000
Total	10, 669, 000	27, 356, 000	38, 025, 000	4, 709, 000

An allowable annual cut from this area has been calculated at 260, 000 cunits. The type of information from which the above tables have been compiled has been found to be optimistic in some remote areas where little field sampling was done. Because of the possibility of such an over estimate, the recommended initial allowable annual cut from this are is 180, 000 cunits. (This is the figure used in the calculations of Section IV-B-2 of this report).

B. Alaska Boundary

The Alaska "Panhandle" cuts off the Yukon and Northern British Columbia from the Pacific Coast. Since any major development of forest industries in the Yukon will depend on large volume shipment to the closest point on tidewater, a satisfactory arrangement for port facilities is required. The possibilities appear to be at Skagway, Haines or Tulsequah (on the Taku River in British Columbia).

IX. PROPOSED MEASURES FOR STIMULATING FOREST DEVELOPMENT

A. Subsidized Transportation System

A reliable economical transportation system must be developed between the interior of the Yukon and an adequate seaport before any pulp industry could be established. The possibility of a seaport on Canadian soil seems to be limited to a point in British Columbia on the Taku River (near Tulsequah). Alternative ports in Alaska are Skagway and Haines.

An analysis of the economics of operating a pulpmill in the Yukon indicates that a mill situated in the vicinity of Carmacks could probably operate with a freight cost to the coast of $8.00 per ton. A mill situated in the Watson Lake area would probably be able to operate with a freight cost $1.00 to $2.00 per ton higher as the cost of logs delivered at the mill would be significantly lower.

Pulpmills in Canada and the United States are located on railroads or on tidewater. Depending on local conditions the break even distance for trucking compared with rail shipment for forest products is between 50 and 150 miles. A railroad in the Yukon, connecting with existing transcontinental railroad systems and with a nearby Pacific Ocean port would provide an ideal transportation system for forest development provided freight rates were not excessive.

Such a development railroad in the Yukon could probably not show a profit initially (using comparable rate structures to other railroads) and some type of governmental subsidy would probably be required. The prime purpose of such a railroad should be to promote development of the Yukon's resources and moderate operating losses should be anticipated until the development is accomplished.

B. Tax Incentives

Various tax concessions could be given to encourage establishment of large forest products industries. Such incentives exist for the mining industry and for businesses establishing in "depressed" areas in Canada. The Yukon is not "depressed" - it is merely "underdeveloped". If a subsidized railroad system (subsidized only to the point where it can offer rates comparable to other railroads) is sufficient to encourage development, no other incentives need be offered. If further incentives are required the economics of the development proposed should be analysed carefully to determine its long term benefit to Canada - it would be unreasonable for the country to subsidize an industry which could not begin to make its own way within a reasonable period of time.

C. Indirect Government Assistance

During the last few years there have been several instances of Provincial Governments in Canada assisting industrial expansion by arranging low interest, long term financing. Governments have even become partners with private industry in the ownership of some manufacturing plants. Assistance of this type would definitely facilitate resource development in the Yukon.

D. Reduced Stumpage and Royalty Rates

In order to attract investment in pulp industries special low "pulpwood" rates have been set in most parts of Canada. In British Columbia, "Smallwood", which is material smaller than that which was previously utilized by the sawmill industry, is priced at $0.55 per cunit. In Alberta the only operating pulpmill pays stumpage of $0.75 per cord, which is equivalent to $0.90 per cunit.

Since the revenues at comparable rates to British Columbia and Alberta will be minimal, it is suggested that payment of stumpage and royalty for pulpwood could well be waived entirely. Whether or not a charge is made, collections of stumpage and royalty from forest industries in the Yukon will probably never be sufficient to pay the expenses of the Yukon Forest Service for administration and fire protection. The work of the Service, however, is indispensable and costs of operation will have to be paid out of general revenues. (The forests will make substantial contributions to general revenues through personal and corporation taxes and through tourism).

E. Simple Forest Administration

A developer will require some type of long term secure tenure for the forest in which he intends to operate. Leases for a period of 21 years with provision for renewal have been found suitable in most other areas.[a]

The control of cutting operations must be worked out between a developing company and the government so that the rules are simple and the company has sufficient flexibility without eliminating governmental authority completely. A written plan with well defined areas of responsibility will be required.

F. Increased Fire Protection

Fire must be better controlled in the major timber areas if any large scale forest development is to take place. Forest fire protection will almost certainly remain the responsibility of the government even after a pulp development is established, and the ability to cope with this problem will have to be demonstrated before the necessary investment capital will be risked.

Over the past 10 years the number of fires has averaged 65 per season with the average size of fire being 4,000 acres. (In the last 3 years the average fire size has dropped to 2,000 acres). Most of the fires in the Yukon are man caused. (only 20 to 40% caused by lightning), and thus the fires are reasonably accessible, but they burn very fast in the normal dry summer.

It is impossible to provide adequate fire protection over the entire Territory and an attempt has been made to divide the area into protected and non-protected zones. A map showing these zones is shown in Appendix VI. A possible improvement to this zone system would be to enlarge the zones and protect all areas in the proximity of the main concentrations of timber which can be easily seen on the Forest Cover Map.

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[a] The 21 year renewable type of tenure is used in Tree Farm Licences and Pulp Harvesting Agreements in British Columbia and in Pulp Leases in Alberta.

Fires in all other areas would be allowed to burn unchecked unless communities were threatened. A continuing program of prevention would cover the entire Territory, of course, but the expensive fire fighting would be restricted to areas where timber values were substantial.

X. AREAS FOR FURTHER STUDY AND RESEARCH

A. Complete Yukon Forest Inventory

A pre-requisite to proper planning and development of any resource is an accurate inventory. A forest inventory program sponsored jointly by Provincial and Federal governments was successful in completing a forest inventory of the provinces between 1951 and 1958, and in most cases this is now being updated. A start was made at the same time on an inventory of the Yukon Forests, but it has not been completed.

It will not be possible to attract forest development without more adequate inventory information and the gathering of the information should not await inquiries from private industry.

B. Economics of Increased Fire Protection

It has been suggested that fire protection can be justified even for protection of caribou range land for the tourist hunter industry. An area of scrub or barren land probably recovers its "productivity" very quickly and the loss from fire may not be too serious.

All aspects of losses due to fire in different types of ground cover and the costs of better fire protection should be thoroughly investigated to permit a proper assessment of fire damage and the economics of protection.

C. Multiple Use of Forest Land

Methods of increasing both tourism and industrial use of the same forests must be found. An interim suggestion of keeping tourists and industrial users as separate as possible is suggested in this study but this cannot be a permanent solution as both the numbers of tourists and the industrial use of the forests will grow simultaneously.

D. Growth Rate Studies

The growth rates calculated in this study are far from exact. The allowable rate of cutting on a sustained yield basis is governed by the growth rate, and it will be necessary to have accurate figures when large scale operations are planned.

E. Effluent Disposal into Lakes and Rivers

In British Columbia a large capital expenditure is required in each pulpmill to provide facilities for treating the effluent before it is discharged into the rivers. This is necessary to protect the valuable salmon fishing industry in the Province.

Some form of effluent treatment will be required in the Yukon as well. This would be required to protect sports fishing in the rivers and lakes which is one of the main attractions to tourists. Since the degree of treatment affects both the capital and operating cost of a pulpmill this problem should be thoroughly investigated to determine requirements.

- APPENDICES -

Appendix I - Volume Summaries By Unit

Klondike Unit

Forest Type	Area (1000 acres)	Volumes in Cunits					
		Softwood			Hardwood		
		4" to 9"	10" plus	Total 4" plus	4" to 9"	10" plus	Total 4" plus
Softwood-Alluvial (mostly sawtimber)	158	1,119,000	995,900	2,114,900	265,200	405,600	670,800
Softwood-Upland (mostly pulp size)	227	1,065,500	308,300	1,373,800	777,600	34,000	811,600
Mature Hardwood	-	-	-	-	-	-	-
TOTALS	385	2,184,500	1,304,200	3,488,700	1,042,800	439,600	1,482,400

Alsek Unit

Forest Type	Area (1000 acres)	Volumes in Cunits					
		Softwood			Hardwood		
		4" to 9"	10" plus	Total 4" plus	4" to 9"	10" plus	Total 4" plus
Softwood-Alluvial (mostly sawtimber)	16	142,200	107,000	249,200	8,900	7,800	16,700
Softwood-Upland (mostly pulp size)	62	417,400	92,100	509,500	22,700	6,800	29,500
Mature Hardwood	-	-	-	-	-	-	-
TOTALS	78	559,600	199,100	758,700	31,600	14,600	46,200

Teslin Unit

Forest Type	Area (1000 acres)	Volumes in Cunits					
		Softwood			Hardwood		
		4" to 9"	10" plus	Total 4" plus	4" to 9"	10" plus	Total 4" plus
Softwood-Alluvial (mostly sawtimber)	100	895,900	673,900	1,569,800	56,200	49,200	105,400
Softwood-Upland (mostly pulp size)	1,338	9,095,400	2,006,300	11,101,700	494,900	147,100	642,000
Mature Hardwood	3	400	100	500	27,400	1,800	29,200
TOTALS	1,441	9,991,700	2,680,300	12,672,000	578,500	198,100	776,600

Appendix I - Volume Summaries By Unit

Pelly Unit

Forest Type	Area (1000 acres)	Volumes in Cunits					
		Softwood			Hardwood		
		4" to 9"	10" plus	Total 4" plus	4" to 9"	10" plus	Total 4" plus
Softwood-Alluvial (mostly sawtimber)	271	1,921,500	1,710,100	3,631,600	455,300	696,500	1,151,800
Softwood-Upland (mostly pulp size)	1,587	7,458,400	2,158,200	9,616,600	5,443,100	238,000	5,681,100
Mature Hardwood	15	9,900	4,400	14,300	140,600	139,500	280,100
TOTALS	1,873	9,389,800	3,872,700	13,262,500	6,039,000	1,074,000	7,113,000

Liard Unit

Forest Type	Area (1000 acres)	Volumes in Cunits					
		Softwood			Hardwood		
		4" to 9"	10" plus	Total 4" plus	4" to 9"	10" plus	Total 4" plus
Softwood-Alluvial (mostly sawtimber)	305	2,417,700	3,590,000	6,007,700	423,200	581,600	1,004,800
Softwood-Upland (mostly pulp size)	3,047	33,451,400	5,818,900	39,270,300	2,102,100	700,700	2,802,800
Mature Hardwood	40	49,000	74,100	123,100	300,100	340,000	640,100
TOTALS	3,392	35,918,100	9,483,000	45,401,100	2,825,400	1,622,300	4,447,700

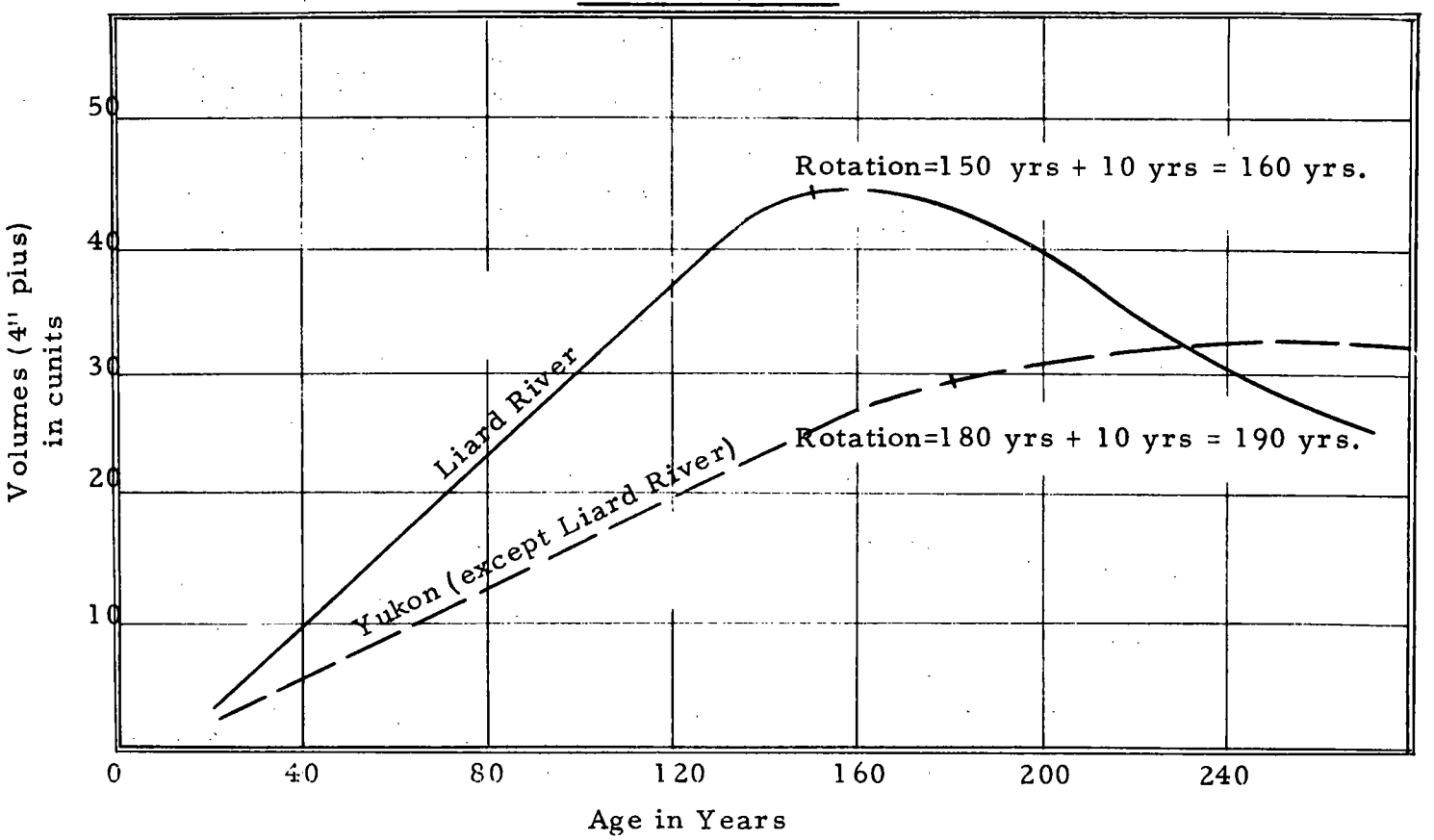
Total All Units

Forest Type	Area (1000 acres)	Volumes in Cunits					
		Softwood			Hardwood		
		4" to 9"	10" plus	Total 4" plus	4" to 9"	10" plus	Total 4" plus
Softwood-Alluvial (mostly sawtimber)	850	6,496,300	7,076,900	13,573,200	1,208,800	1,740,700	2,949,500
Softwood-Upland (mostly pulp size)	6,261	51,488,100	10,383,800	61,871,900	8,840,400	1,126,600	9,967,000
Mature Hardwood	58	59,300	78,600	137,900	468,100	481,300	949,400
TOTALS	7,169	58,043,700	17,539,300	75,583,000	10,517,300	3,348,600	13,865,900

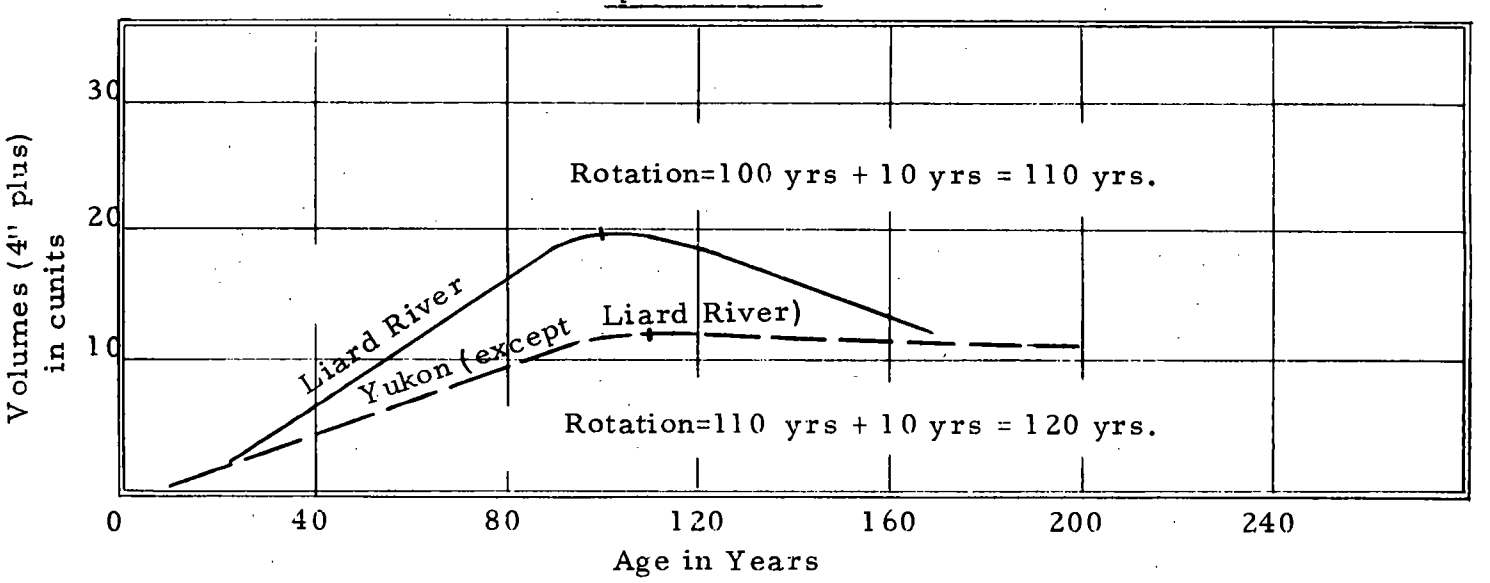
Appendix II

Volume Over Age Curves

Alluvial Forests



Upland Forests



Appendix III

Allowable Cut Calculations

The softwood allowable cut was calculated for each development unit by three methods as follows:

1. Hanzlik's Formula

$$\text{Allowable Cut} = \frac{\text{Mature Volume}}{\text{Rotation}} + \text{Immature Area} \times \text{Growth Rate}$$

In this calculation the volume in alluvial types was separated from the volume in upland types and the respective rotation used.

2. Von Mantel's Formula

$$\text{Allowable Cut} = \frac{2 \times \text{Total Volume}}{\text{Rotation}}$$

Volumes on alluvial and upland types were separated and the appropriate rotations applied.

3. Productive Area Potential

$$\text{Allowable Cut} = \text{Area of Productive Forest} \times \text{Growth Rate}$$

Productive type areas were multiplied by the appropriate growth rates and the upland type was increased by the 25% of the burn area which is considered to be potentially productive.

The following table shows the results of these calculations:

	Allowable Annual Cut (cunits)			
Unit	Hanzlik	Von Mantel	Potential	Recommended
Klondike	30,100	45,100	43,200	30,000
Alsek	9,800	11,100	11,000	9,000
Teslin	194,400	201,600	231,900	195,000
Pelly	152,200	198,500	163,700	150,000
Liard	707,300	789,100	867,900	710,000
TOTALS	1,093,800	1,245,400	1,317,700	1,094,000

Appendix IV

Economic Analysis Of Various Types Of Pulp Industries

A. Bleached Kraft Pulpmill

1. The requirements for a bleached kraft pulpmill are as follows:

Investment	-	$80,000,000	- for a 750 ton per day mill
		$45,000,000	- for a 300 ton per day mill which is probably the smallest economic size possible.
Employment	-	1.2 to 1.5 man days per ton	
Wood	-	1.70 cunits per ton	
Water	-	45,000 gallons per ton	
Electric Power	-	750 kilowatt hours per ton	
Fuel	-	1 barrel of bunker fuel or 5,700,000 B.T.U.'s per ton	
Chemicals	-	Saltcake (Na_2SO_4)	75 lbs. per ton
	-	Limestone rock	80 lbs. per ton
	-	Chlorine (Cl_2)	125 lbs. per ton
	-	Caustic (NaOH)	110 lbs. per ton
	-	Sodium Chlorate ($NaClO_3$)	65 lbs. per ton
	-	Sulphuric Acid (H_2SO_4)	45 lbs. per ton
	-	Sulphur Dioxide (SO_2)	20 lbs. per ton

Dr. Howard Rapson, Professor of Chemical Engineering, University of Toronto, has developed a new chemical supply system for kraft pulp mills which has had limited field testing.[1] Dr. Rapson recommends this system for remote areas as the entire chemical supply could be furnished from sulphur, salt, limestone and fuel many of which might be available locally.

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1 Dr. W. H. Rapson, A New Chemical Supply System for Kraft Pulping and Bleaching, Pulp and Paper Magazine of Canada, May, 1965.

2. The operation of a bleached kraft pulpmill in the Yukon has been compared with operation in the interior of British Columbia at Prince George, where three new mills have been brought into production in recent years. Differences in operating costs in the Yukon are as follows:

(a) Wood supply
- approximately $5.00 higher per ton of pulp in the Yukon.

(b) Cost of inventory
- a larger inventory of logs and chips would be required in the Yukon and this could cost about $0.60 per ton more. The larger inventory would be necessitated by using rivers to transport wood to the pulpmill.

(c) Transportation
- based on construction of suitable railroad and costs approximately 20% higher than in British Columbia.
- importing chemicals and fuel-cost approximately $5.00 more per ton in the Yukon.
- shipping finished product to the coast-estimated saving of $.50 per ton in the Yukon.

(d) Pulpmill operation
- all costs expected to be similar to Prince George except in the woodroom which will require a drum barker and equipment for handling smaller logs and could increase the cost in the Yukon by $2.00 per ton.

3. In summary it appears that the cost of operating a bleached kraft pulpmill in the Yukon would exceed the costs of operating a similar mill at Prince George, B.C. by $10.00 to $15.00 per ton of pulp. This difference could be reduced slightly depending on stumpage charged, which averages $3.50 to $5.00 per ton in the Prince George area.

B. Newsprint Mill

The requirements for a newsprint mill are as follows:

Investment	-	$100,000,000 for a 1000 ton per day mill
Employment	-	2.0 man days per ton approximately
Wood	-	0.95 cunits per ton
Water	-	60,000 gallons per ton
Electric Power	-	1530 kilowatt hours per ton
Fuel	-	1 barrel of fuel oil per ton
Chemicals	-	since newsprint is about 80 percent groundwood and about 20 percent kraft pulp the chemical requirements are only 20% of the amount previously shown for kraft pulp.

Since there are no newsprint mills presently operating in the interior of British Columbia it is not possible to make an easy comparison. Power and water requirements are higher than for a kraft mill and it is expected that these items will not be more expensive in the Yukon. A small amount of chemicals are required and this is an advantage in the Yukon where transportation costs will be high.

There has been a much smaller increase in demand for Canadian newsprint than has been expected[1], and this may continue.

Although the Yukon timber resource is suitable for the manufacture of newsprint a large increase in world demand would have to develop to ensure a successful operation. Present markets are almost entirely in the United States and all other Canadian forest areas would have freight advantages.

1 P. E. Lachance, The Gordon Commission, Concerning the Pulp and Paper Industry Eight Years Later, Pulp and Paper Mfg. Canada, Woodlands Review, May, 1964.

C. Refiner Groundwood Mill

The refiner groundwood process is a relatively new development in pulping.[1,2] No chemicals are used and wood chips are converted to pulp through a series of disc refiners. The product is a long fibre pulp with extremely good strength characteristics. Satisfactory newsprint can be made using 95% refiner groundwood and 5% semi-bleached kraft pulp, whereas 20 to 25% kraft or sulphite pulp is required for newsprint made from the traditional stone groundwood. Refiner groundwood pulp can be flash dried and baled for shipment.

Requirements for a refiner groundwood mill are as follows:

Investment	-	$4,000,000 to $5,000,000 per 100 tons of daily capacity.
Employment	-	approximately 1.5 man days per ton.
Wood	-	0.90 cunits per ton.
Water	-	approximately 50,000 gallons per ton.
Electric Power	-	1800 to 2000 kilowatt hours per ton.

Japanese interests are proposing at least two refiner groundwood plants in British Columbia. One of the proposed locations is in the Rocky Mountain Trench about 125 miles north of Prince George. One of the pulp sites in the Yukon would be much closer to the Pacific Coast than this British Columbia location.

If a transportation system is established which could move materials between a coast port and one of the pulpmill sites in the Yukon at reasonable cost (not exceeding $8.00 per ton) a refiner - groundwood mill might be brought into production in about 10 years. A further condition for this development would be availability of low cost power (priced in the 4 to 5 mill range - total cost of demand and energy).

Any combination of freight and power rates amounting to $16.00 to $18.00 per ton would be reasonable as an increase in power rate of 1 mill results in a $2.00 per ton increase in production costs.

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1. Paper Trade Journal, October 23, 1967

2. J.A. Cochrane and H.F. Crotogino, Refiner Groundwood from Western Canadian Woods, Pulp and Paper Mag. of Canada, July, 1965.

D. Chip Export

A barking and chipping installation with a capital investment of about $500,000. could produce approximately 300 units of chips per day.[a] Costs have been calculated as follows:

Barking and chipping	$ 8.50 per unit
Logging to central plant	$16.50 per unit
Chip transport 200 miles to coast (based on CNR Rail Rates + 10%)	$ 6.00 per unit
Total cost (no allowance for stumpage)	$31.00 per unit

A recent price reported to have been offered by the Japanese for a long term chip supply on the British Columbia coast is $24.50 per unit. The current price paid by British Columbia coast pulpmills is $15.00 to $16.00 per volumetric unit or $19.50 to $21.00 per bone dry unit. Alaska pulpmills have quoted prices of $22.00 to $23.00 per unit.

It would appear that, unless there is a large increase in chip prices (25%), export of chips could not be economical. In the event of any significant increase in chip prices, the costs of operating a chip pipeline to the coast should be investigated.

Presently indicated prices and costs, however, would not permit any transport of chips.

E. Log Export

The possibility was investigated of shipping pulp logs to the coast for sale on the open log market or export to Alaskan or Japanese pulpmills. Costs are estimated as follows:

Logging to central shipping point	$16.50 per 100 cu. ft.
Rail shipment to the coast - based on Pacific Great Eastern Railway log haul rates	$15.00 per 100 cu. ft.
Total Cost	$31.50 per 100 cu. ft.

a Units used in this report are 2400 lb. bone dry units and are approximately equal to 1.3 volumetric (200 cubic feet) units or 100 cubic feet of solid wood.

The present market price for spruce pulp logs on the British Columbia coast is $23.00 per 100 cu. ft.[a] Most British Columbia logs cannot be exported and currently the Japanese are purchasing better quality spruce logs for up to $50.00 per 100 cubic feet. Spruce from the Yukon would be smaller and would not command such a high price. It is unlikely that a steady market could be developed at high enough prices to permit economical export of Yukon logs.

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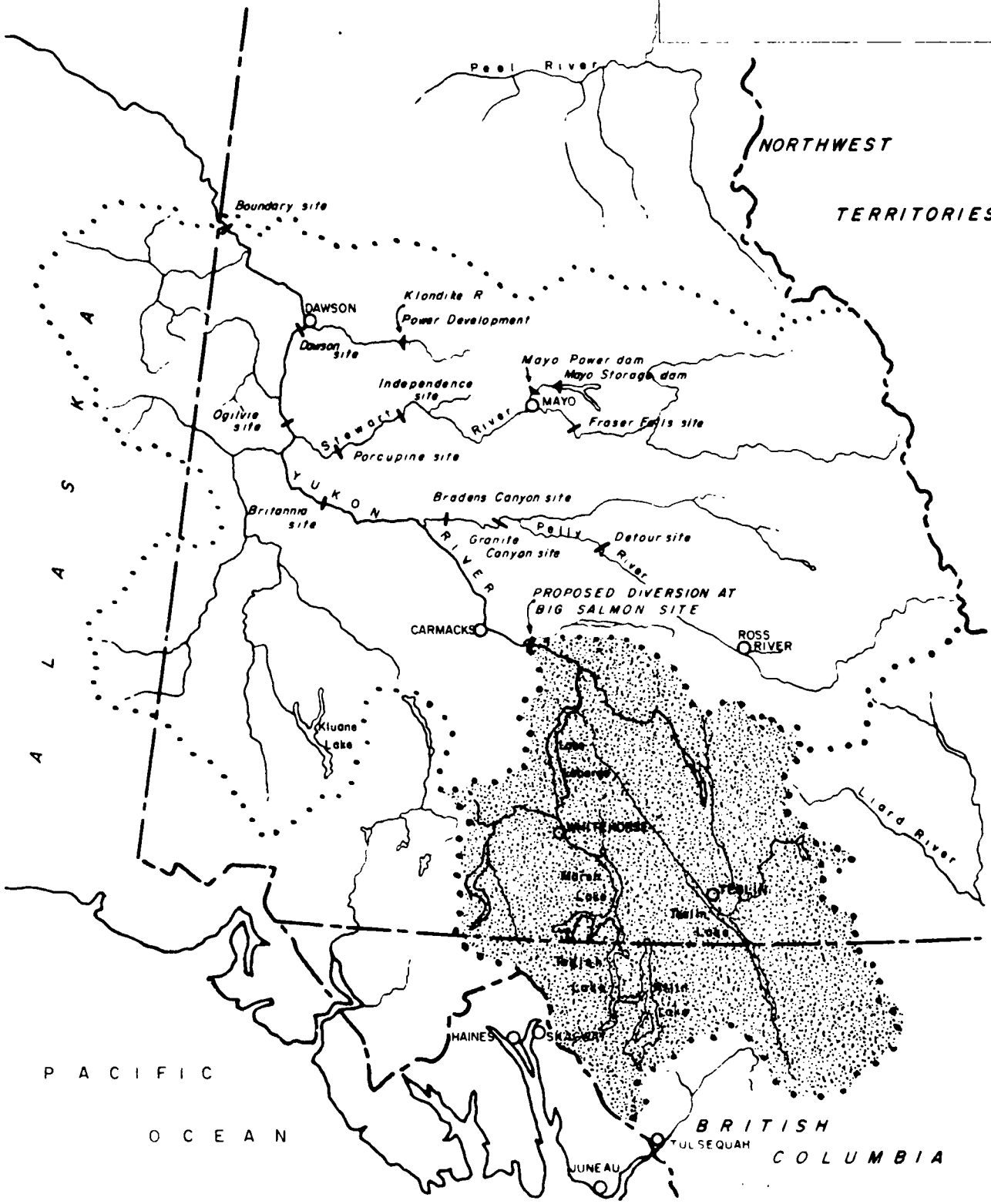
a From log price quotations in The Truck Logger Magazine, October and November, 1967.

APPENDIX V

KEY MAP

PROPOSED HYDRO-POWER DEVELOPMENT

SCALE 70 miles to 1 inch



from a map prepared by the Department of Northern Affairs and National Resources Water Resources Branch, Vancouver B C 1962

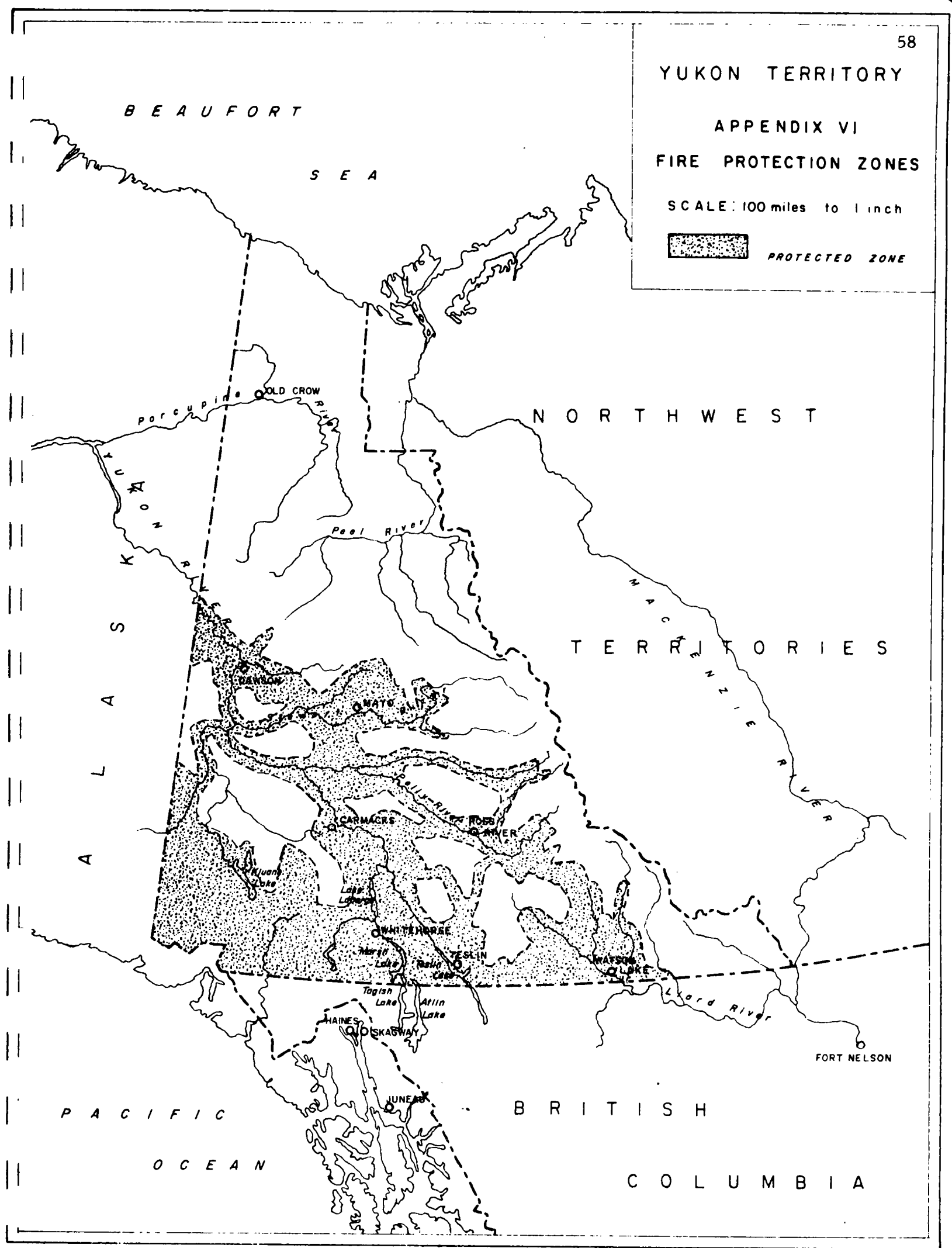
YUKON TERRITORY

APPENDIX VI

FIRE PROTECTION ZONES

SCALE: 100 miles to 1 inch

PROTECTED ZONE



Appendix VII

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Wellwood, Dr. R.W., Professor of Forest Products at the University of British Columbia, Vancouver, B.C.

White Pass and Yukon Route, Petroleum Services Division, Whitehorse, Yukon.

Appendix VIII

Forest Cover Map

(no map)